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THE DECLINE IN MERCURY CONCENTRATION IN FISH FROM LAKE ST. CLAIR, 1970-1976

May, 1977

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Ministry
of the
Environment

Ontario

The Honourable
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Minister

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Deputy Minister

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THE DECLINE IN MERCURY CONCENTRATION IN FISH FROM LAKE ST. CLAIR, 1970 - 1976

REPORT NO. AQS77-3

LABORATORY SERVICES BRANCH
MINISTRY OF THE ENVIRONMENT

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Summary

The report summarizes the mercury analytical results in 8800 fish representing 31 species from Lake St. Clair over the seven year period 1970 - 1976. Relationships between mercury concentration and fish size were developed for those species with significant data bases. Generally the concentration of mercury increased as fish length or weight increased, and the mercury concentration was higher for predatory species than for bottom-feeding species. The relationships between mercury concentration and size were used to compare the mercury levels in fish of similar size over the seven year period, and the pattern of the reduction in mercury levels was found to closely approximate an exponential decline. Using the equations for the exponential decline, predictions were made as to when average sizes of the most common species of fish in Lake St. Clair would fall below the current 0.5 ppm guideline for mercury in fish.

The mercury content of fish from Lake St. Clair is now less than half of what it was in 1970, and this dramatic decline is attributed to the reduction of mercury discharge by the Dow Chemical chlor-alkali plant in Sarnia as a result of control orders issued by the MOE (then the OWRC), and to the translocation of mercury contaminated sediments from Lake St. Clair to Lake Erie.

Conclusions:

1) The mercury concentrations in all species of fish from Lake St. Clair have declined significantly since 1970. In general, the concentration of mercury in fish from Lake St. Clair is less than half of what it was in 1970.

2) If present trends continue, most common sizes of most species should have mercury levels below the current federal guideline of 0.5 ppm within the next five years.

3) The application of stringent controls on the Dow Chemical Company's chlor-alkali plant in Sarnia by the M.O.E. (then the O.W.R.C.) in 1970, and the subsequent decline in mercury available for biosynthesis, along with the transport of mercury-laden sediments out of the St. Clair system by natural processes, has been responsible for the decline observed in mercury concentrations in fish.

4) There is a need to examine trends in mercury levels in fish from Lake Erie to assess the effects of the translocation of mercury from Lake St. Clair, and to continue the annual surveys on Lake St. Clair to monitor the rate of decline.

5) The concentration of mercury increased as fish sizes increased, for all species tested.

6) The mercury concentration was generally higher in predacious fish than in bottom-feeding species.

7) The use of the log-log transformed regression model is a satisfactory means of describing the relationship between mercury concentration and fish size. This model provides the basis for forecasting the point in time by which representative fish for a given species will fall below the federal guideline.

Introduction

Elevated levels of mercury in fish from Lake St. Clair (see Fig. 1) were first noted in 1969 (1). The major contributor to the mercury pollution of the St. Clair River and Lake St. Clair was identified as the Dow Chemical chlor-alkali complex at Sarnia. It is estimated that the losses of mercury averaged 30 pounds per day in 1969 (2). In March, 1970, the Ontario Water Resources Commission (now part of the Ministry of the Environment) issued an order requesting the cessation of mercury discharge, and losses of mercury were curtailed. Since May of 1970, mercury discharges to the St. Clair River have been negligible.

The Canadian Department of Fisheries impounded fish from the Lake St. Clair fishery in March 1970, and closed the fishery in April, 1970. Since then, commercial fishing for all species has been closed in Lake St. Clair, the St. Clair River, and the Detroit River.

In the fall of 1970, a program was designed by the O.W.R.C. and the Ministry of Natural Resources to sample the fish populations of Lake St. Clair to determine mercury levels in the fish. The program had three objectives:

a) to establish the degree of mercury contamination in fish from Lake St. Clair.
b) to determine the effect of the cessation of industrial discharge of mercury into the St. Clair River on the mercury content of fish.
c) to predict if and when the mercury concentration of the fish would fall to levels meeting current guidelines.

Since 1970, over 8800 fish representing 31 species have been collected and analyzed. The purpose of this report is to summarize the information from 1970 to 1976, and examine the trends in the levels of mercury in a number of key species.

There are two aspects of mercury and its contamination of fish relevant to the situation in Lake St. Clair. The first is that virtually all the mercury in fish from Lake St. Clair is in the monomethylmercury form (3), (see Fig. 2) and the second is that the mercury concentration increases with increasing fish size (see Figs. 4 to 12). Since the industrial discharge of mercury was primarily in inorganic forms (metallic mercury, or mercuric chloride of sulfide compounds) the transformation of inorganic forms of mercury to methylmercury is germane to the Lake St. Clair situation.

The following three sections of the report provide a synopsis of the current understanding of the mechanisms of mercury methylation and the uptake of methylmercury by fish.

a) Methylation of Mercury in Aquatic Ecosystems

When the causative agent of the mass poisonings in Minamata, Japan was first identified as a mercury compound, the exact form of the mercury was unknown. Uchida et al. (4) isolated it as methyl (thiomethyl) mercury. Kurland (5) in 1960 and Fujiki (6) in 1963, suggested that this might be formed naturally through marine organisms. However, this line of investigation was abandoned when Irukayama et al. (7) demonstrated that methylmercury was formed as a by-product of the acetaldehyde process in the Chisso Corp. in Minimata.

While developing analytical methods for organomercurials, Westöö (8-11) noticed that the form of mercury in fish was methylmercury, regardless of whether the source of mercury contamination in the area was phenylmercury, methoxyethylmercury, inorganic mercury, or methylmercury. This prompted a series of experiments by Jensen and Jernelov concerning the natural formation of methylmercury (12-14). They observed that when aquarium mud was spiked with mercuric chloride and incubated aerobically, detectable levels of methylmercury could be observed within five days. When the sediment was sterilized, however, no methylmercury was formed, but reinoculation of the sediment with a bacterial culture returned its methylating capability. They also observed that a rotting fish homogenate produced significant quantities of both mono- and dimethylmercury, under aerobic or anaerobic conditions.

Further experiments (15-17) on the mercury cycle in the environment demonstrated that the ionic mercury necessary for methylation could be produced from metallic mercury, mercuric sulfide, or phenylmercury under natural oxidative conditions (22, 23, 37). Another factor affecting methylation was pH. Jernelov observed that dimethylmercury was the preferred end product at high pH, while monomethylmercury predominated at low pH's (18). Fish mucus was also found to be capable of methylating mercury.

These observations stimulated interest in several other research groups. Miettinen and his colleagues (19, 20) noted methylation of mercury under aerobic and anaerobic conditions in various sediments and sludges. No dimethylmercury was formed, but the sediments were generally acidic. They concluded that temperature and the organic content of the sediments were more important than aerobiosis in controlling the rate of methylation. That the mercury methylation was of biological origin was confirmed when no methylmercury was observed in gamma irradiated or autoclaved sediments. Bishop (21) observed methylation under both aerobic and anaerobic conditions. He found that the amount of mercury methylated was dependent on the concentration of soluble mercury, and he linked the methylation to methanogenic bacteria in the sediment. Methylation was stimulated by the addition of organic wastes (21, 27).

FIGURE 1: LAKE ST. CLAIR

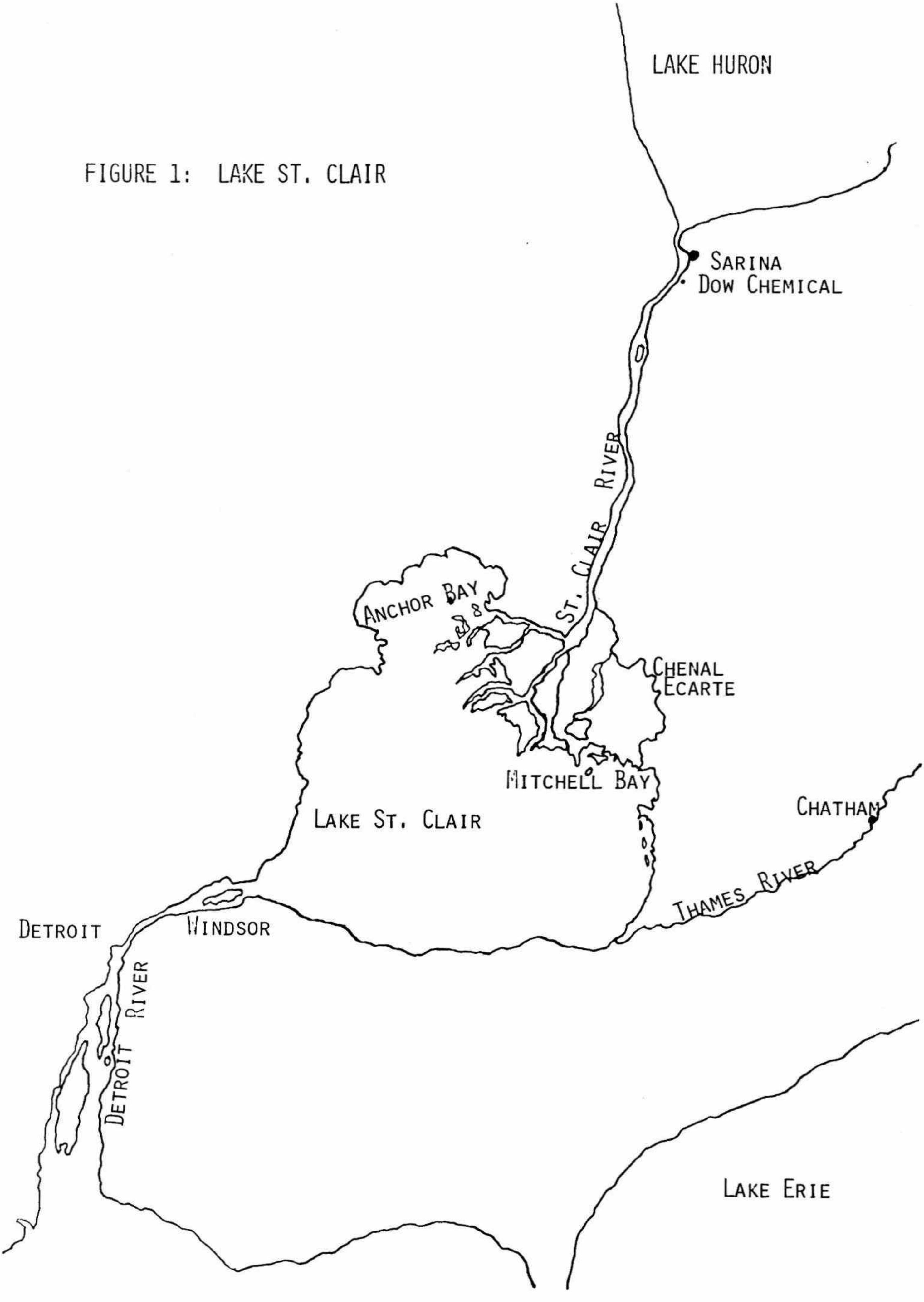
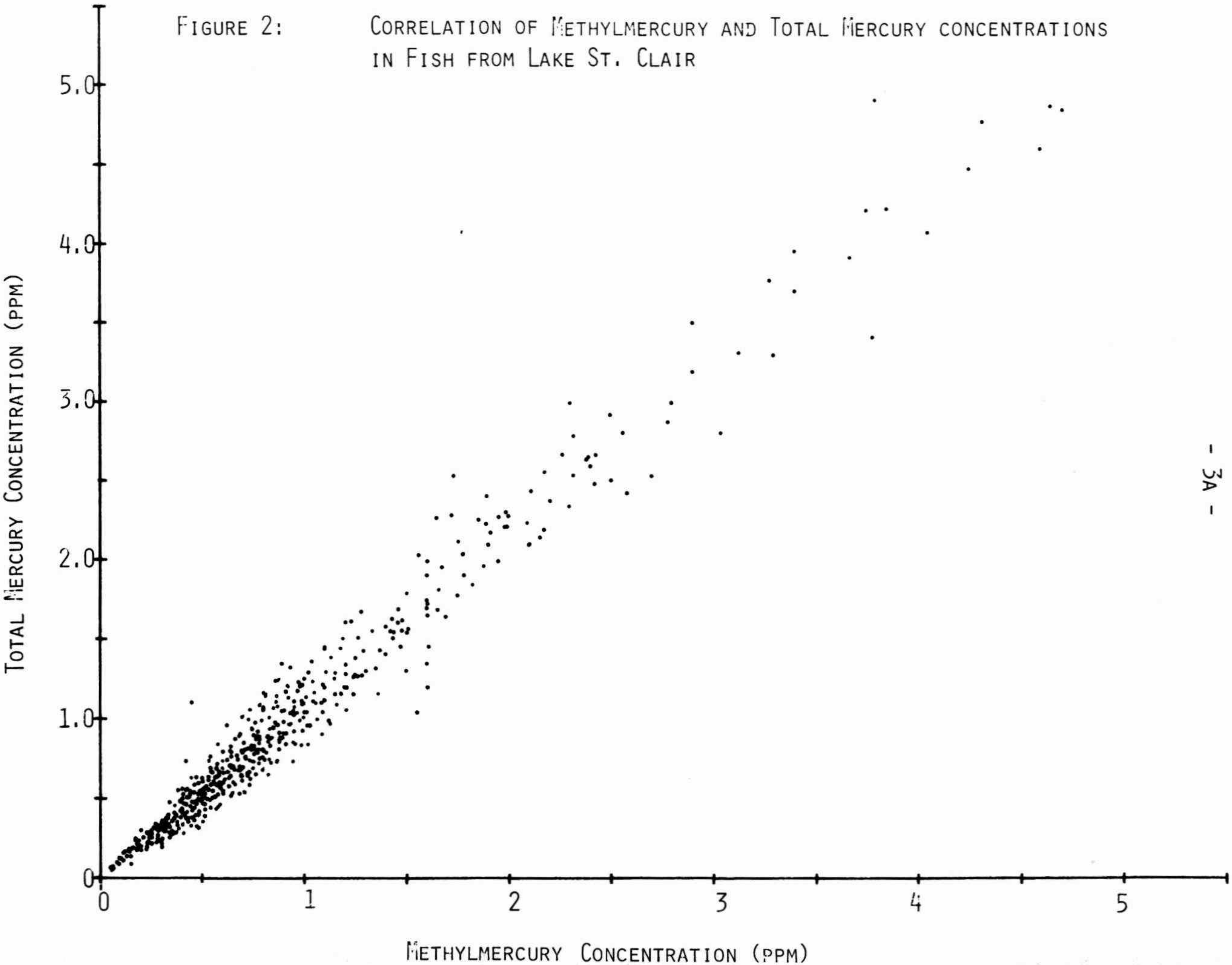


FIGURE 2: CORRELATION OF METHYLMERCURY AND TOTAL MERCURY CONCENTRATIONS IN FISH FROM LAKE ST. CLAIR



Fish have been used as indicators of methylmercury production by several groups (23-26). Increases in the organic content of the sediment and sediment microorganism populations were found to increase the release of methylmercury from the sediment and were found to have an inhibitory effect on methylation. Observable methylation during *in situ* equilibration has also been reported.

Efforts to isolate the microorganisms responsible for the methylation of mercury in sediments have been largely unsuccessful. Kitamura et al., (28) were able to isolate a strain of *Pseudomonas* from soil capable of methylation, and another strain of *Pseudomonas* isolated from the mucus coat of fish have also been demonstrated to methylate mercury. Yamada et al. (28, 31-33) identified a soil microorganism (*Clostridium cochlearium*) capable of anaerobic methylation of many inorganic mercury compounds in pure culture. The addition of vitamin B_{12} was found to stimulate the methylation. Vonk and Sjepsteijn (34) noted small amounts of methylmercury being produced in aerobic and anaerobic cultures of five bacterial species, and noted methylation by mutant, mercury resistant *Neurospora crassa* strains.

In addition to the methylation of mercury, microorganisms are capable of demethylating alkylmercurials and degrading other organomercurials. Reduction and volatilization of inorganic mercury compounds is well recognized (38-44). Tonomura et al. (45-47) observed a *Pseudomonas* strain, later designated K62 (33,48), that was capable of degrading methy-, ethyl-, and phenylmercurials to their respective hydrocarbons and metallic mercury. Cultures isolated from soils and sediments are also capable of decomposing phenylmercurials to benzene and mercury (49, 50). The occurrence of the resistant bacteria capable of degrading organomercurials has been found to be proportional to the mercury concentration in the sediment (51, 52). *In situ* decomposition of organomercurials in soil (53) and sludge (54) has also been noted.

The presence of bacteria in the environment capable of demethylating methylmercury has been demonstrated by Spangler et al. (57, 58) and Billen et al. (59). Demethylating and methylating bacteria in human feces have also been observed (60). The relative environmental significance of the methylating and demethylating processes is difficult to assess. Fish can absorb methylmercury from water with a very high efficiency, and sediment has a very high affinity for inorganic mercurials.

In a mercury contaminated ecosystem, these form the two major compartments for organic and inorganic mercury, respectively. In areas with high levels of mercury contamination, the increase in methylmercury content in fish would suggest that methylation occurs at a greater rate than demethylation but a "critical concentration" of mercury in sediment that leads to a net methylation has not been determined.

The biochemical mechanism for the methylation of mercury has been the subject of considerable research. Wood and his co-workers (63-67) noted that extracts of methanogenic bacteria could methylate mercury. Using NMR and photometric methods, he proposed a mechanism for mercury methylation involving nonenzymatic transfer of the methyl group from methylcobolamin (methylated vitamin B_{12}) to mercuric ions in the presence of ATP and a mild reducing agent. Methyl transfer from organocobalt compounds to mercury had been noted as early as 1964(62). Imura et al. (68), Bertillson and Neujahr (69) and Schrauzer et al. (70) demonstrated that abiotic transfer of the methyl group from methylcobolamin or methylcobaloximes in neutral water solutions proceeded almost quantitatively under both aerobic and anaerobic conditions. Landner (35, 36) has suggested another mechanism to explain methylation by the mold Neurospora crassa involving the "incorrect" synthesis of methionine from the methylation of mercury substituted homocysteine.

The mechanism of the demethylation process has also been investigated. Tonomura et al. (33, 71-37) identified two enzymes capable of degrading methylmercury, mercuric chloride and other organomercurials from Pseudomonas K62, one of which was identified as a flavoprotein. The actual redox reaction is accomplished via reduction of cytochrome c-1, supplying the electrons necessary to split the mercury-carbon bond. These enzymes have been shown to be inducible in Pseudomonas (74).

The reducing ability of bacteria appears to be directly related to their mercury resistance (48, 50-52). The mercury resistance is carried on inducible and transferrable R-plasmids in the bacteria (44, 75-77).

The presence of both methylating and demethylating bacteria complicates the estimation of the actual methylation rates involved, since the observed formation reflects the net, rather than gross methylation rate (61). However, the observation of elevated levels of methylmercury in fish lends support to the conclusion by Shin (78), "Presumably, a balance (between methyation and demethylation) is maintained in aquatic systems in which the synthesis of methylmercury is favoured".

b) Methylmercury Accumulation in Fish

Given the production of methylmercury by bacteria in mercury contaminated sediments, the method by which the mercury is accumulated in fish is important for an understanding of both the nature of the problem, and the statistical approach taken.

Early reports of mercury levels in fish (79, 80) indicated some increase towards higher trophic levels, and the food chain was thought to be the prime accumulation route. In 1960, Boetius (81) demonstrated that fish can also accumulate both mercuric and phenylmercuric compounds directly from water. The environmental importance of water uptake was first demonstrated by Hasselrot in 1968 (82) who reported that salmon kept in cages drownstream of pulp mill effluent containing phenylmercury had elevated mercury levels compared to those upstream of the mill. It would appear from this and other caging studies (83,84) that water uptake is also of importance in the environment. The work of de Frietas et al. (85) supported this by comparing the distribution of mercury in various organs of fish experimentally contaminated by food or water with the mercury-organ distributions of environmentally contaminated fish. The pattern observed in the environment approximated that observed in the water uptake distribution study.

Jernelov (86, 87) on more intuitive grounds, estimated that fish high on the food chain obtain 50% of their mercury through water, and the remainder of it through food, while fish lower on the food chain obtained about 75% of their mercury burden via water.

One factor of importance in the uptake of mercury by fish is the form of the mercury. Hannerz (88) exposed fish to various mercury compounds and found that fish absorb short chain alkylmercurials at a far greater rate than aryl, alkoxyalkyl, or ionic mercurials. Backstrom (89), using autoradiographic techniques, confirmed that methylmercury was much more quickly incorporated into the general muscle mass of the fish than other mercurials. In addition, methylmercury has a much longer half-life in fish than other mercurials. This preferential uptake and retention is the most probable explanation for the fact that virtually all of the mercury in fish is in the monomethylated form (2, 8-11).

Quantitative estimates of the ability of fish to concentrate mercury from water have resulted in bioaccumulation factors ranging from 3000 for pike (90,91) to over 8000 for trout (92), although Burrows et al. (93) have noted that laboratory uptake studies do not necessarily reflect environmental uptake rates. The fact that fish are very efficient accumulators of methylmercury has been exploited in several studies (23-26, 94) to demonstrate the methylation of mercury in sediments.

Olson et al. (95) demonstrated that the main route of uptake of methylmercury was via the gills, though in a subsequent study with an electron microprobe (96) he was unable to find a specific site for the binding of the mercury. Gill uptake of ethyl mercury was also demonstrated by Rucker and Amend (97, 98), who noted a rapid transferral of the alkylmercurial to the blood and muscle. Although absorption via the gills has been postulated as the main route of accumulation (82, 85, 88, 89, 96-98), significant uptake of mercuric (99) and methylmercuric ions (93) in the mucus layer of the fish have been reported, and uptake through the skin has been postulated (100).

The fact that the metabolic rate of the fish is regulated by the water temperature is perhaps the most important factor in determining the rate of mercurial uptake by fish. The observation that fish concentrated more mercury in the summer than the winter was noticed in early field studies (82, 83) and increased uptake at higher water temperatures has been confirmed in several experiments (85, 88, 92, 98, 101, 102). Backstrom (89) noted that the red muscle of fish had a more rapid uptake of mercury than white muscle and attributed this to the higher metabolism of the red muscle.

The elimination of mercury also appears to be largely governed by temperature (85), and should be considered when values for the half-life of methylmercury in fish are examined. Half-life values for mercury in fish kept in natural environments range from 2 years (1, 3, 105) to no significant reduction even after 2 years (84, 124). For laboratory studies of fish artificially contaminated with mercury, a two stage elimination process has been noticed (93, 104). The rapid, first stage of elimination is thought to be due to the sloughing of the mucus layer coating the skin, and the second stage reflects loss from the muscle tissue. Estimates of the half-life of this second stage of elimination include 130 days for bluegill (93), 1000 days for rainbow trout (104), 780 days for flounder, 750 days for pike, and 910 days for eel (106).

These elimination half-lives, however, are of little relevance as they are partially due to a dilution of the mercury by the formation of new flesh, (124) and because the natural transformation of an environment from being mercury contaminated to being non-contaminated is a gradual process.

c) Mercury Concentration in Relation to Fish Size

The mercury concentration of a fish, then, is determined by a variety of factors: metabolic rate, methylmercury concentration in food and water, and duration of exposure. The variation of mercury with the size and age of fish was first noted by Swedish investigators in the 1960's (107, 108). This variation reduced the utility of the mean and range of mercury concentrations in fish populations, since they would be a function of the mean size of the fish forming that population. This was recognized and the concept of a "standard" fish was developed. This, in practice, was a "1-kg pike", the mercury concentration of which was derived from a simple interpolation from the linear regression of the mercury concentration on fish weight. The "1-kg pike" was used to facilitate comparisons of mercury contamination in fish from different areas of Sweden (100, 109).

The Swedish scientists used a linear regression model ($y= a + bx$) to describe the relationship between mercury concentration and fish age or weight. However, a geometric regression model ($y=ax^b$) has been used more widely in Canada. For this regression model, both axes (mercury and length or weight) are transformed logarithmically. Forrester, Ketchen, and Wong (110) noted "mercury content varied curvilinearly with body length" when examining the mercury concentration in spiny dogfish. Scott and Armstrong (111) examined a large data base from fish in northwestern Ontario and noted that "computations were carried out on both untransformed data and on natural-log transformed variables. The latter proved to be appropriate for both linearizing the relationships and uncoupling means and variances". As a result of this and other work done by Scott (112), the Fisheries Inspection Branch uses log-log transformed data (or geometric regression) for relating mercury concentration to fish size.

In addition to statistical considerations there are other bases for selecting a geometric model for the regression. Several mathematical models have been developed that describe the uptake of mercury in freshwater food chains (113 -116). All of these models predict nonlinear mercury-size relations, and the most realistic model (116), developed at the NRC in Ottawa, specifically predicts a geometric relationship. Therefore, although linear (117-119), or exponential regression models (120) are still used by some researchers, a geometric model seems to be the best from both statistical and theoretical standpoints.

In this study, three of the interrelationships of measurable fish parameters were calculated using three different regression models: geometric, exponential, and linear. The results of 48 sets of regressions were tabulated to see which regression model offered the best description (highest correlation coefficient). The results (Table 1) indicate that the geometric regression model produces the best fit to the data more often than the other regression models.

TABLE 1

COMPARISON OF REGRESSION MODELS

Model Producing The Highest Correlation	Mercury vs. Fish Length	Mercury vs. Fish Weight	Fish Weight vs. Fish Length
Geometric	43.7%	56.2%	93.7%
Expontential	39.6%	16.7%	2.1%
Linear	16.7%	27.1%	4.2%

In most instances there are significant correlations between the mercury concentration and fish length, fish weight, and the age of the fish. Of these three relationships, the one between mercury and length appears to be the most useful from a practical standpoint of estimating the mercury concentration of the fish from a field-measurable parameter. In 33 of the 48 regressions examined, the correlation coefficient of the mercury-length relationship was higher than that of the mercury-weight relationship. The correlation with weight suffers from a daily variation associated with feeding (111), but even when this is accounted for (by taking the weight of the fish minus the weight of the gastrointestinal tract) the mercury-length correlation is usually better (119).

The age of the fish, although correlated with the mercury concentration (107, 108, 119), is difficult to measure. In addition Olsson (119) in reporting on a study of pike of similar age groups states "...since there is a significant mercury/length correlation within age groups and since approximately equal mercury concentrations are found in three different age groups within a joint length range, it is obvious that the metabolic turnover - parameters of size directly correlated with this - of the specimens is more important than age or exposure time in determining mercury levels in fish".

As noted previously, the metabolic rate of the fish (in addition to the mercury concentration in the environment) is the single most important factor in determining its mercury concentration. This concept has been used in mathematical models of mercury uptake by fish, and is consistent with the observation of significant relationships between mercury concentration and fish length (or weight) since the metabolic rate of a fish is a function of its size (121), among other factors.

In addition, there is often a difference in the mercury-length relationship between males and females of the same species (110, 119). This reduces the mercury-length correlation coefficients if the data from both sexes are pooled. The difference, attributable to differences in growth rates between the sexes, can often be quite marked (See Figure 3). However, in view of the difficulties involved in determining the sex of a (live) fish, the data presented in this report has not been broken down to distinguish between males and females, because one of its objectives is to provide information on the fish population as a whole, and producing the correlations on a sex-specific basis would reduce the practical utility of the information.

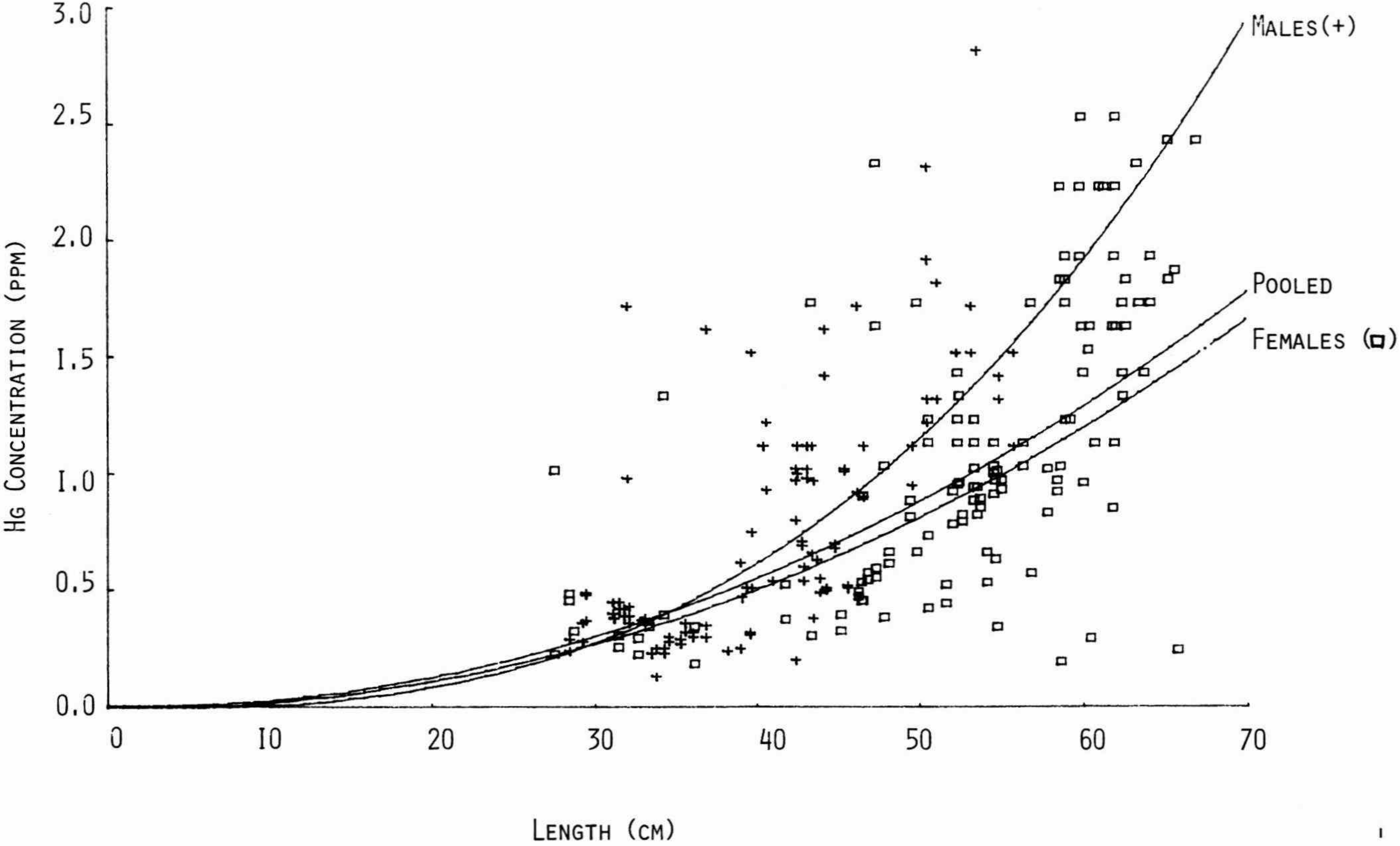
Fish Collection

For all years (1970-1976) except 1975, fish were captured by Ministry of Natural Resources and Ministry of the Environment staff. Specimens were captured by pound and trawl net in locations shown in Figure 1. To reduce variation from year to year, samples were always taken in October and early November.

The 1975 collection was taken by commercial fishermen and Ministry of Natural Resources. The sampling was done only for a defined number of fish in restricted size ranges for each species, so the 1975 population is not strictly comparable with those from other years.

All fish captured had the species, length, weight, and sex recorded by field personnel. Immediately after capture, the fish were frozen until analysis for mercury. See Appendix IV for a list of common and proper names of fish species.

FIGURE 3: 1976 ST. CLAIR WALLEYE
MERCURY: LENGTH REGRESSIONS; MALES, FEMALES, AND POOLED POPULATION



Analysis

Since 1970, a variety of methods for the determination of total mercury in fish were used in the Mercury Laboratory of the O.W.R.C./M.O.E. All the methods were based on the flameless atomic absorption procedure originally developed by Hatch and Ott (122). The methylmercury analysis were done according to a method based on Rudling (123). The details of the analytical methods are included in Appendix 1.

Results

a) Mercury Data Summaries

Summaries of the information from each of the surveys are listed in Tables 2 to 8. The ranges for mercury concentration (Hg conc.), length and weight are given in brackets after the arithmetic mean. The column marked % > = 0.5 shows the percentage of that species whose mercury concentration equalled or exceeded the 0.5 ppm guideline.

The arithmetic mean of the mercury concentration is included in these tables for information only. As has been discussed earlier, the mercury concentration in fish is correlated to fish size. Therefore, the average mercury concentration will fluctuate according to the average size of fish comprising each year's sample. For this reason, mean mercury concentrations should not be compared for any species from one year to another, since different sizes of fish are likely to be caught in different years.

Further, the average is not a very good estimate of the median mercury concentration. In a log-normally distributed population such as mercury concentrations in fish, the geometric mean is a better estimate of the median.

1976 LAKE ST. CLAIR FISH MERCURY LEVELS

TABLE 2

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	% > =0.5ppm	MEAN	RANGE	MEAN	RANGE
BLACK CRAPPIE	48	0.69	0.22-2.0	63	23.3	18.0-28.4	258	100- 432
BLUEGILL	7	0.63	0.47-0.80	71	19.3	15.6-21.8	197	108- 295
CARP	104	0.79	0.16-1.5	76	53.8	33.5-75.4	3434	835-8855
CHANNEL CATFISH	56	0.77	0.35-1.9	82	53.1	22.3-67.8	22	200-3897
LARGEMOUTH BASS	16	1.3	0.89-2.1	100	32.0	22.9-39.6	596	204-1033
MUSKELLUNGE	4	0.79	0.24-1.8	50	80.7	74.4-97.3	4629	3343-7900
PIKE	50	1.6	0.20-3.8	92	68.4	45.4-91.9	2393	596-6000
PUMPKINSEED	4	0.57	0.35-0.77	75	18.8	17.0-20.0	175	134- 198
ROCK BASS	80	1.1	0.17-2.2	88	20.9	14.4-25.9	213	63- 365
SMALLMOUTH BASS	28	1.2	0.11-2.9	96	35.1	17.6-46.3	802	153-1600
WALLEYE	246	0.93	0.11-3.0	66	47.3	27.4-70.6	1273	205-4087
WHITE BASS	61	0.91	0.10-2.0	77	31.5	20.9-44.3	617	154-1096
WHITE SUCKER	24	0.83	0.06-1.9	70	42.5	34.6-49.9	1108	580-2114
YELLOW PERCH	14	0.98	0.11-2.9	71	22.4	17.7-26.5	159	70- 250

1975 LAKE ST. CLAIR FISH MERCURY LEVELS

TABLE 3

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	%> = 0.5ppm	MEAN	RANGE	MEAN	RANGE
BLACK CRAPPIE	30	0.48	0.16-0.98	40	23	20-25	-	-
BLUEGILL	4	0.74	0.71-0.80	100	20	18-20	-	-
CARP	33	0.57	0.14-1.0	61	50	41-56	-	-
CHANNEL CATFISH	82	0.65	0.18-1.7	57	46	33-56	-	-
FRESHWATER DRUM	29	0.79	0.23-1.5	83	31	23-43	-	-
GAR PIKE	1	4.10	-	-	69	-	-	-
GIZZARD SHAD	1	0.08	-	-	36	-	-	-
MOONEYE	3	0.47	0.38-0.61	33	31	30-33	-	-
MUSKELLUNGE	4	1.5	0.65-3.7	100	90	76-109	-	-
PIKE	4	1.8	0.88-2.2	100	73	66-79	-	-
QUILLBACK CARPSUCKER	22	0.38	0.09-1.3	27	41	36-48	-	-
REDHORSE SUCKER	20	1.1	0.21-2.4	75	43	36-56	-	-
ROCK BASS	33	0.83	0.45-1.7	97	20	15-25	-	-
WALLEYE	69	0.81	0.16-1.9	73	44	33-53	-	-
WHITE BASS	48	0.70	0.13-1.6	75	28	23-33	-	-
WHITE SUCKER	33	0.78	0.13-2.1	79	45	36-53	-	-
YELLOW PERCH	22	0.59	0.23-1.5	36	22	18-25	-	-

TABLE 4

1974 LAKE ST. CLAIR FISH MERCURY LEVELS

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	%>= 0.5 ppm	MEAN	RANGE	MEAN	RANGE
BLACK CRAPPIE	67	0.89	0.17-3.7	76	23.0	13.0-29.5	247	35-550
BLUEGILL	45	0.84	0.35-1.2	87	19.2	12.3-23.0	191	43-330
BROWN BULLHEAD	2	1.0	0.97-1.1	100	32.3	31.9-32.7	436	435-437
CARP	67	0.69	0.09-1.5	70	48.0	37.5-83.3	2448	1015-1157
CHANNEL CATFISH	59	0.93	0.24-3.5	80	48.2	26.4-65.5	1752	210-4535
FRESHWATER DRUM	62	0.64	0.08-4.1	48	28.5	19.5-47.5	297	70-1295
LARGEMOUTH BASS	19	2.0	0.52-4.7	100	32.5	18.7-41.8	567	95-1220
PIKE	50	2.5	0.90-6.8	100	74.1	46.7-92.7	2866	690-5275
PUMPKINSEED	74	0.57	0.19-1.2	58	17.6	13.5-20.9	158	65-270
QUILLBACK CARPBUCKER	26	0.72	0.09-1.8	50	39.2	33.6-43.9	1378	760-2125
REDHORSE SUCKER	51	0.92	0.12-2.2	69	37.8	23.3-55.3	899	125-2845
ROCK BASS	69	1.1	0.22-2.4	93	20.2	13.4-28.0	191	50-365
SMALLMOUTH BASS	45	1.5	0.55-4.8	100	35.0	17.5-47.8	800	85-1945
WALLEYE	590	0.98	0.10-3.2	78	41.8	14.3-67.7	959	27-2125
WHITE BASS	70	0.79	0.19-2.2	60	26.4	19.9-34.7	354	115-855
WHITE CRAPPIE	2	0.23	0.17-0.29	0	24.8	23.0-26.5	234	195-273
WHITE SUCKER	51	0.93	0.11-2.1	73	40.8	27.6-50.2	900	46-1645
YELLOW PERCH	259	0.36	0.08-1.68	23	17.0	5.5-28.2	87	4-315

TABLE 5

1973 LAKE ST. CLAIR FISH MERCURY LEVELS

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	%>= 0.5 ppm	MEAN	RANGE	MEAN	RANGE
ALEWIFE	69	0.13	0.04-0.37	0	12.9	5.7-16.5	24	2- 41
BLACK CRAPPIE	162	0.61	0.06-2.6	57	18.1	5.3-33.5	142	5-530
BLUEGILL	194	0.62	0.17-1.5	53	14.0	3.0-22.0	101	2-345
BOWFIN	4	2.7	1.1 -4.5	100	51.9	45.5-60.0	1343	870-2028
BROOK SILVERSIDES	27	0.16	0.11-0.26	0	6.5	6.1- 7.0	1	1-2
BROWN BULLHEAD	109	0.95	0.17-2.3	88	30.7	21.0-37.0	455	205-3365
CARP	105	0.91	0.12-2.6	83	50.1	28.0-74.0	2750	425-7037
CHANNEL CATFISH	100	0.97	0.37-2.5	96	50.8	30.5-66.5	1864	320-4420
EMERALD SHINER	48	0.23	0.12-0.43	0	7.7	5.0- 9.6	5	1-14
FRESHWATER DRUM	102	0.84	0.14-2.5	75	31.7	18.0-56.0	431	65-1860
GAR PIKE	4	1.7	0.09-4.4	50	51.2	44.2-61.5	219	120-363
GIZZARD SHAD	9	0.09	0.05-0.12	0	24.5	3.7-34.0	366	1-730
GOLDEN SHINER	63	0.29	0.11-0.59	10	8.3	5.5-11.5	7	1-20
LARGEMOUTH BASS	46	1.1	0.08-3.1	67	23.9	4.0-43.0	396	1-1325
MOONEYE	26	0.26	0.18-0.42	0	14.5	11.2-29.0	50	14-355
MUSKELLUNGE	4	4.4	1.1 -8.5	100	85.9	73.5-91.0	5434	2860-8310
PIKE	101	2.5	0.30-6.5	97	65.6	27.3-92.5	2082	132-5370
PUMPKINSEED	136	0.68	0.13-1.6	70	15.5	7.5-20.5	117	10-280
QUILLBACK CARPSUCKER	39	0.97	0.06-3.2	74	38.4	9.5-48	1325	8-2890
REDHORSE SUCKER	51	1.2	0.08-6.6	73	37.6	26.5-60.0	902	290-3750

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1973 LAKE ST. CLAIR FISH MERCURY LEVELS

TABLE 5 (Cont'd)

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT(g)	
SPECIES	N	MEAN	RANGE	%>=0.5ppm	MEAN	RANGE	MEAN	RANGE
ROCK BASS	112	1.1	0.23-3.8	90	19.5	9.1-27.0	179	17-420
SMALLMOUTH BASS	66	1.4	0.43-3.5	94	33.2	22.5-49.5	738	210-2150
SPOTTAIL SHINER	67	0.37	0.12-0.62	6	8.4	4.4-11.0	8	1-12
TROUT PERCH	10	0.25	0.14-0.50	10	6.7	5.7- 9.0	4	2- 9
WALLEYE	291	1.1	0.13-5.0	80	40.2	13.0-67.5	853	22-3095
WHITE BASS	99	1.2	0.19-2.0	86	27.3	10.5-33.5	406	16-710
WHITE CRAPPIE	10	0.32	0.07-1.2	20	11.2	5.6-24.0	46	2-201
WHITE SUCKER	51	1.2	0.22-3.1	82	40.8	7.8-49.0	979	6-1655
YELLOW PERCH	375	0.45	0.08-2.1	30	16.2	6.6-29.0	69	4-395

1972 LAKE ST. CLAIR FISH MERCURY LEVELS

TABLE 6

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	%>= 0.5 ppm	MEAN	RANGE	MEAN	RANGE
BLACK CRAPPIE	39	1.1	0.23- 2.6	77	19.9	11.0-29.5	177	20-510
BLUEGILL	16	1.2	0.69- 1.5	100	17.9	15.0-20.5	153	90-235
BOWFIN	17	4.2	0.52-10.0	100	52.9	39.2-59.0	1407	535-1955
BROWN BULLHEAD	6	1.1	0.58-1.5	100	31.2	27.2-35.2	435	275-545
BURBOT	2	4.1	3.3 -4.8	100	64.4	58.7-70.0	1933	1315-2550
CARP	31	1.1	0.31-2.3	84	49.7	36.5-60.4	2657	1035-4865
CHANNEL CATFISH	63	1.3	0.53-2.8	100	50.2	42.8-61.7	1781	910-365
FRESHWATER DRUM	47	0.69	0.05-1.9	62	29.1	18.6-49.8	322	50-1265
LARGEMOUTH BASS	12	2.7	0.66-6.8	100	31.6	23.5-41.2	606	210-1360
MUSKELLUNGE	1	5.0	-	-	76.7	-	3970	-
PIKE	38	4.3	2.3 -9.9	100	71.3	56.0-85.2	2479	1080-4535
PUMPKINSEED	49	1.2	0.21-2.8	94	16.8	10.1-20.5	142	30-250
QUILLBACK CARPSUCKER	7	1.5	0.3 -3.8	71	39.6	33.1-45.0	1542	925-2115
REDHORSE SUCKER	30	1.7	0.07-9.1	83	37.4	27.2-55.4	913	310-3095
ROCK BASS	315	1.9	0.22-5.7	99	18.9	11.6-27.5	163	30-410
SMALLMOUTH BASS	87	2.4	0.30-6.7	99	33.4	19.5-48.2	696	115-1760
WALLEYE	436	1.3	0.13-7.1	83	33.5	12.2-68.5	581	15-3100
WHITE BASS	55	2.0	0.34-5.5	93	28.1	20.0-37.3	430	120-970
WHITE SUCKER	36	1.4	0.25-4.0	92	41.8	34.5-39.8	1033	585-1465
YELLOW PERCH	357	0.9	0.05-3.3	67	17.9	5.0-28.9	87	1-300

TABLE 7

1971 LAKE ST. CLAIR FISH MERCURY LEVELS

		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	%>=0.5ppm	MEAN	RANGE	MEAN	RANGE
BLUEGILL	9	1.2	0.69- 1.5	100	17.5	15.0-18.8	141	90-175
BOWFIN	13	6.0	0.75-11.6	100	53.7	39.2-65.5	1532	535-2790
BROWN BULLHEAD	8	1.7	1.1 - 2.9	100	29.7	25.7-32.9	371	210-515
CARP	29	1.7	0.30- 3.3	93	48.6	30.0-58.2	2436	550-4065
CHANNEL CATFISH	13	1.5	0.76- 2.8	100	52.0	48.3-56.2	2026	1350-2965
FRESHWATER DRUM	30	1.3	0.18- 3.6	90	32.6	21.2-41.5	459	105-1015
GIZZARD SHAD	3	0.16	0.04- 0.28	0	13.3	12.0-15.0	31	18-45
LARGEMOUTH BASS	1	3.2	-	-	30.1	-	490	-
MUSKELLUNGE	8	7.1	1.8 -23.0	100	91.3	71.5-116.5	6639	2930-13500
PIKE	43	3.9	0.29- 8.5	98	66.0	50.4-85.5	2155	905-6020
PUMPKINSEED	6	1.7	1.4 - 2.3	100	14.1	10.1-18.7	88	30-215
ROCK BASS	40	3.10	1.4 - 6.3	100	20.4	14.5-25.2	211	80-375
SMALLMOUTH BASS	79	3.3	1.1 - 7.2	100	32.8	19.9-39.9	670	130-1175
WALLEYE	350	1.8	0.13-13.1	96	35.1	15.0-63.1	599	38-2365
WHITE BASS	1	1.4	-	-	28.0	-	430	-
YELLOW PERCH	70	1.5	0.13- 3.5	90	16.0	6.8-31.2	99	4-390

1970 LAKE ST. CLAIR FISH MERCURY LEVELS

TABLE 8

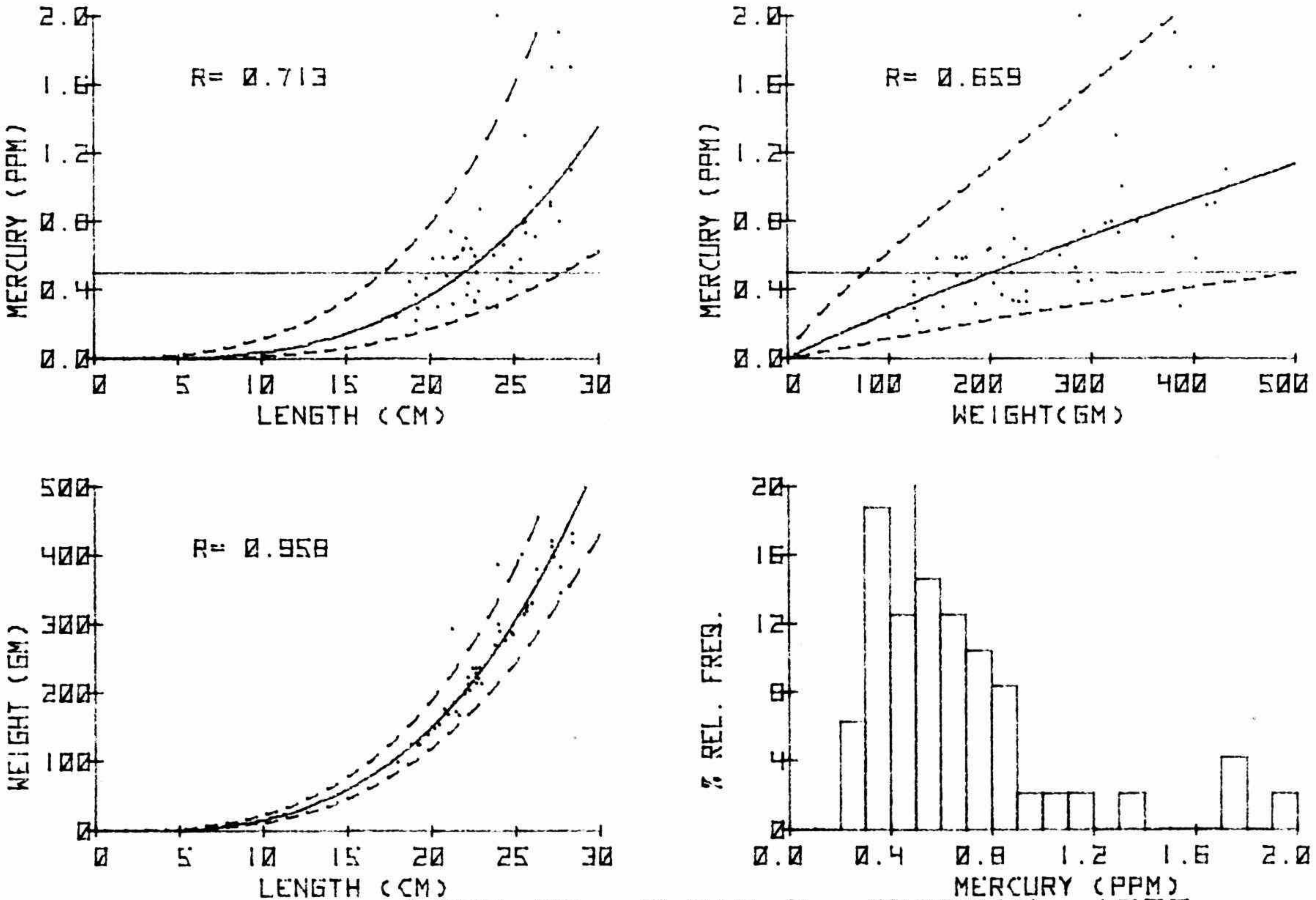
		MERCURY CONCENTRATION (ppm)			LENGTH (cm)		WEIGHT (g)	
SPECIES	N	MEAN	RANGE	%>= 0.5 ppm	MEAN	RANGE	MEAN	RANGE
ALEWIFE	8	0.34	0.27-0.43	0	8.0	8.0- 8.0	5	5-5
BLACK CRAPPIE	25	3.3	1.0 -6.1	100	22.8	16.1-28.4	231	61-517
BLUEGILL	16	2.2	1.2 -3.2	100	14.7	11.3-19.8	88	25-220
BOWFIN	1	9.9	-	-	59.0	-	2000	-
BROWN BULLHEAD	4	2.8	0.51-4.5	100	29.9	28.2-32.0	325	260-450
CARP	18	1.5	0.27-4.2	78	48.9	34.0-73.5	2323	680-8310
CHANNEL CATFISH	56	1.1	0.33-3.0	86	36.2	15.4-56.7	1273	50-2722
FRESHWATER DRUM	9	1.3	0.49-2.0	89	27.2	21.0-34.0	259	100-420
LARGEMOUTH BASS	2	3.9	2.9 -4.9	100	35.7	32.8-38.6	785	570-1000
MUSKELLUNGE	7	4.3	1.7 -7.6	100	69.3	51.4-95.8	2449	700-5980
PIKE	29	4.4	0.61-9.9	100	63.6	43.0-82.8	1932	500-3870
PUMPKINSEED	29	2.1	0.68-4.7	100	18.2	17.1-20.0	170	105-214
QUILLBACK CARPSUCKER	4	2.3	1.3 -4.1	100	39.5	37.5-42.5	1329	1180-1645
REDHORSE SUCKER	1	6.3	-	-	41.5	-	737	-
ROCK BASS	35	3.4	0.97-10.7	100	19.8	12.6-29.7	185	41-345
SMALLMOUTH BASS	30	3.0	1.0 - 6.9	100	32.3	22.0-44.0	625	220-1430
STURGEON	1	0.51	-	-	67.3	-	2310	-
WALLEYE	615	2.1	0.23-14.0	99	34.9	11.7-65.0	640	13-3010
WHITE BASS	59	2.2	0.47- 5.7	98	25.7	11.5-33.4	314	21-700
YELLOW PERCH	245	1.9	0.02- 8.2	96	21.2	11.7-31.5	136	8-525

b) Regressions

Figures 4 to 12 are graphic representations of the relationships between fish weight and fish length, mercury concentration and fish length, and mercury concentration and fish weight. Also displayed are histograms showing the relative frequency of occurrence of different mercury concentrations in each species. The solid curve through the points is the geometric regression curve, and the dashed lines are the 95% prediction limits about the regression. A horizontal line has been drawn on the mercury regression plots to indicate the current 0.5 ppm guideline for mercury in fish flesh. The correlation coefficients for the regressions are also displayed on the graphs.

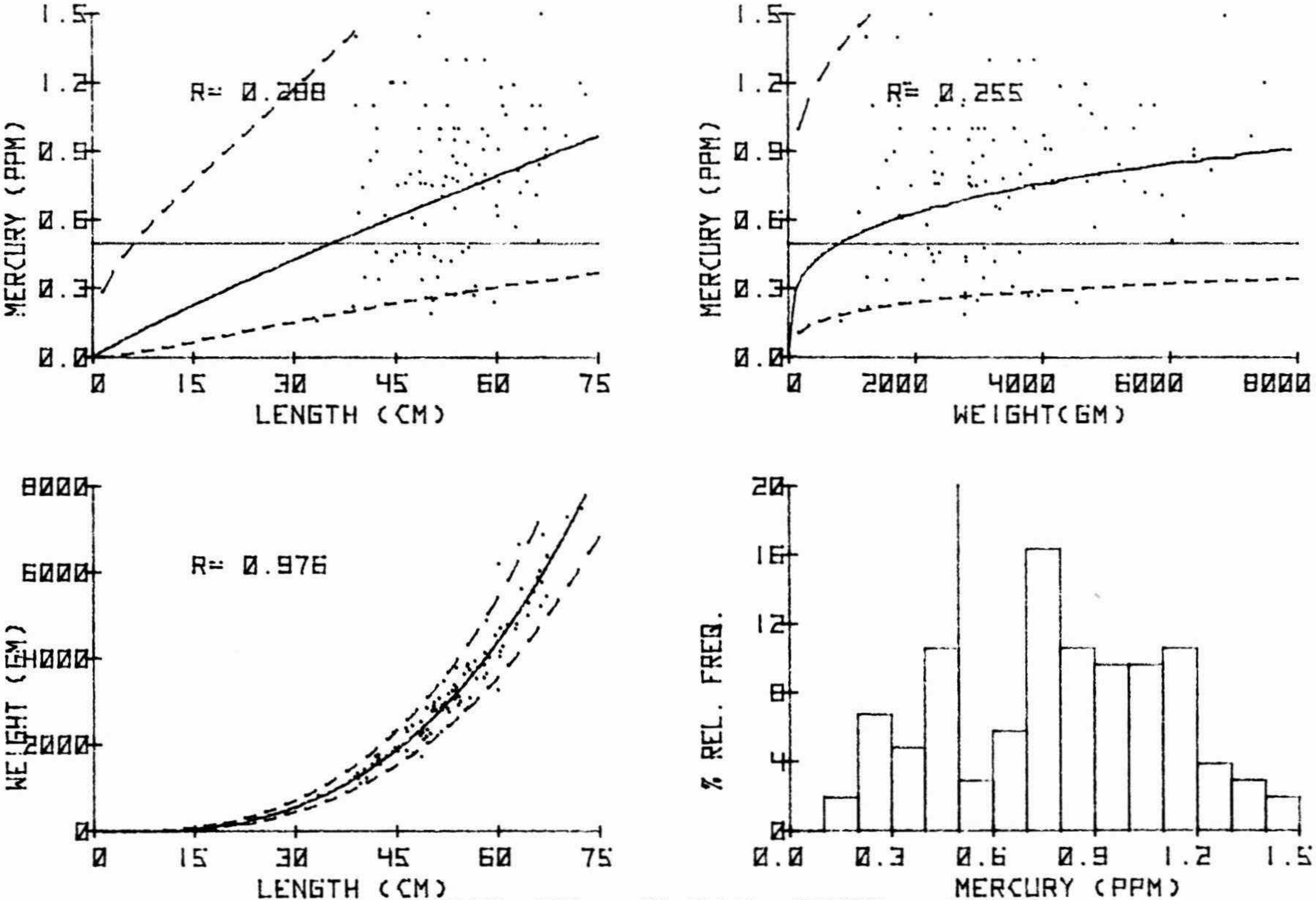
The regression coefficients are tabulated in Appendix II.

FIGURE 4



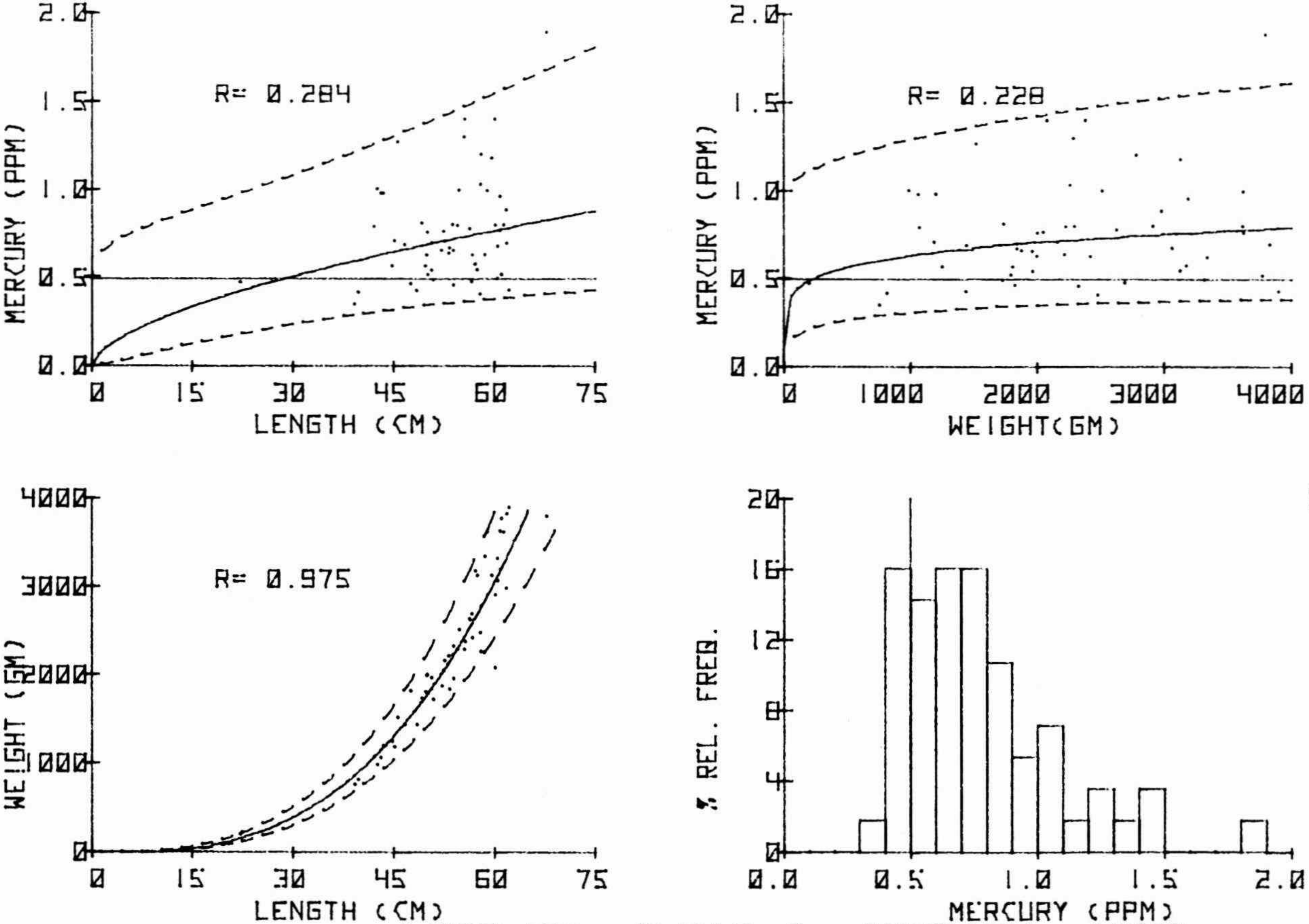
LAKE ST. CLAIR B. CRAPPIE, 1976

FIGURE 5



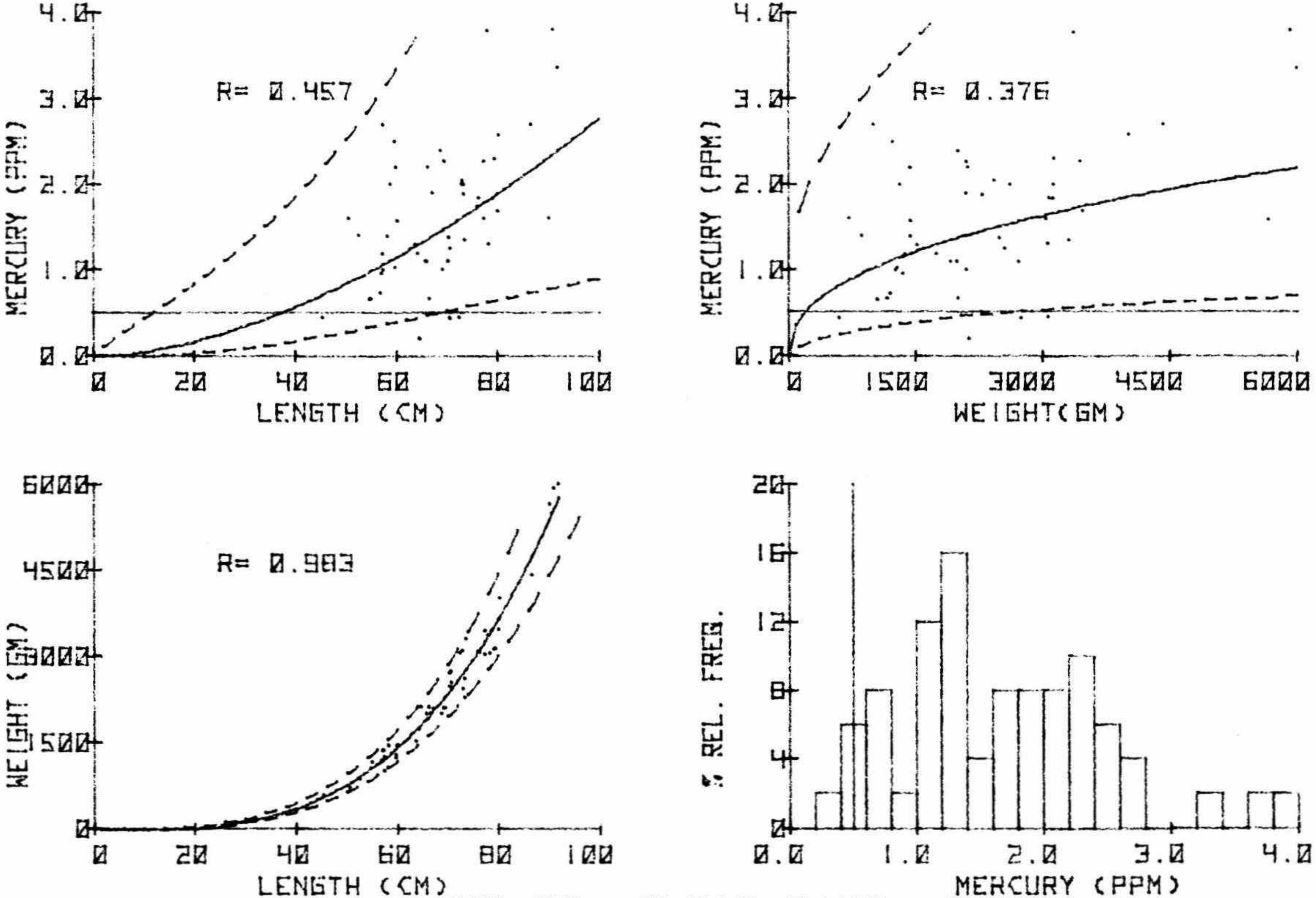
LAKE ST. CLAIR CARP, 1976

FIGURE 6



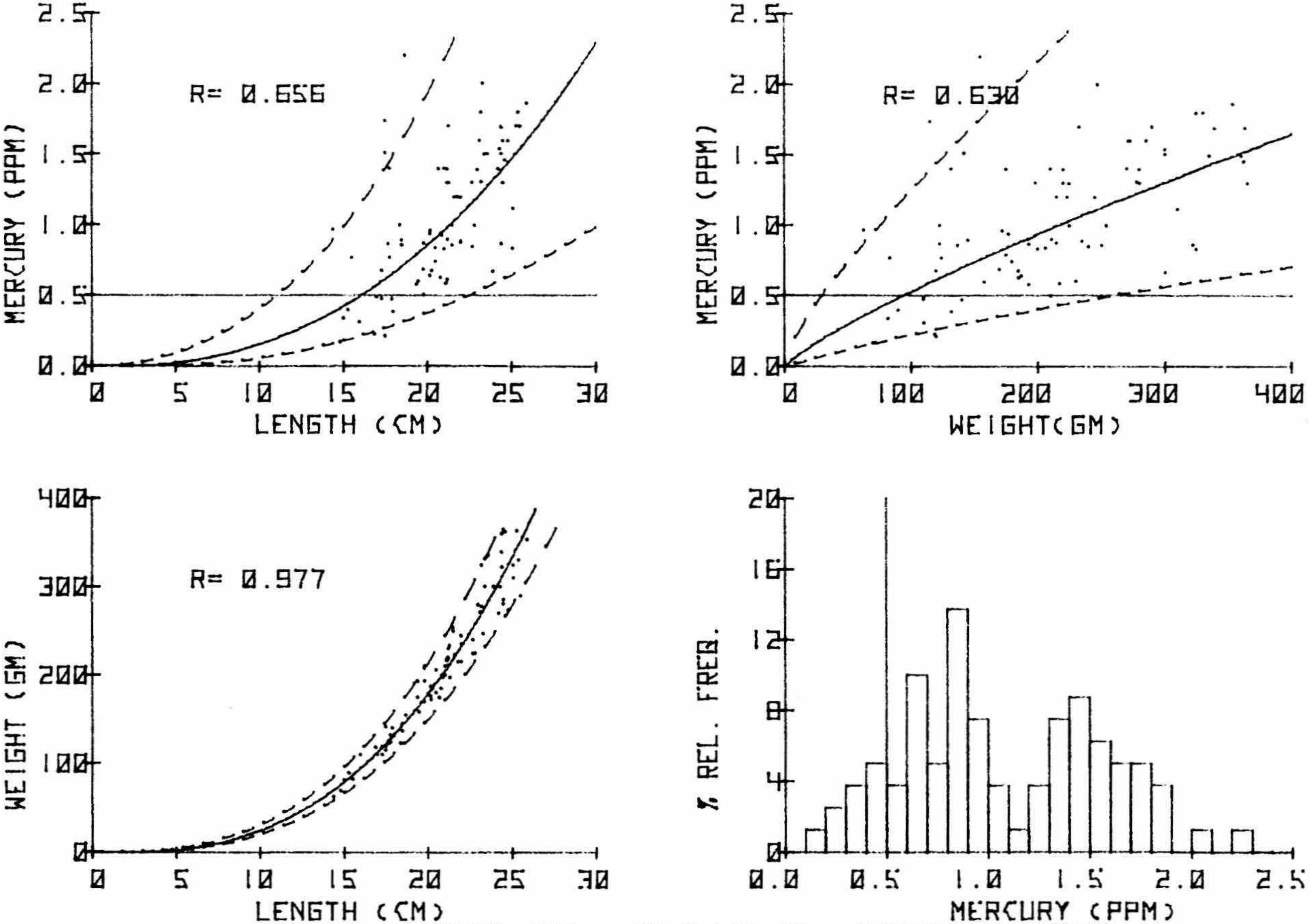
LAKE ST. CLAIR C. CATFISH, 1976

FIGURE 7



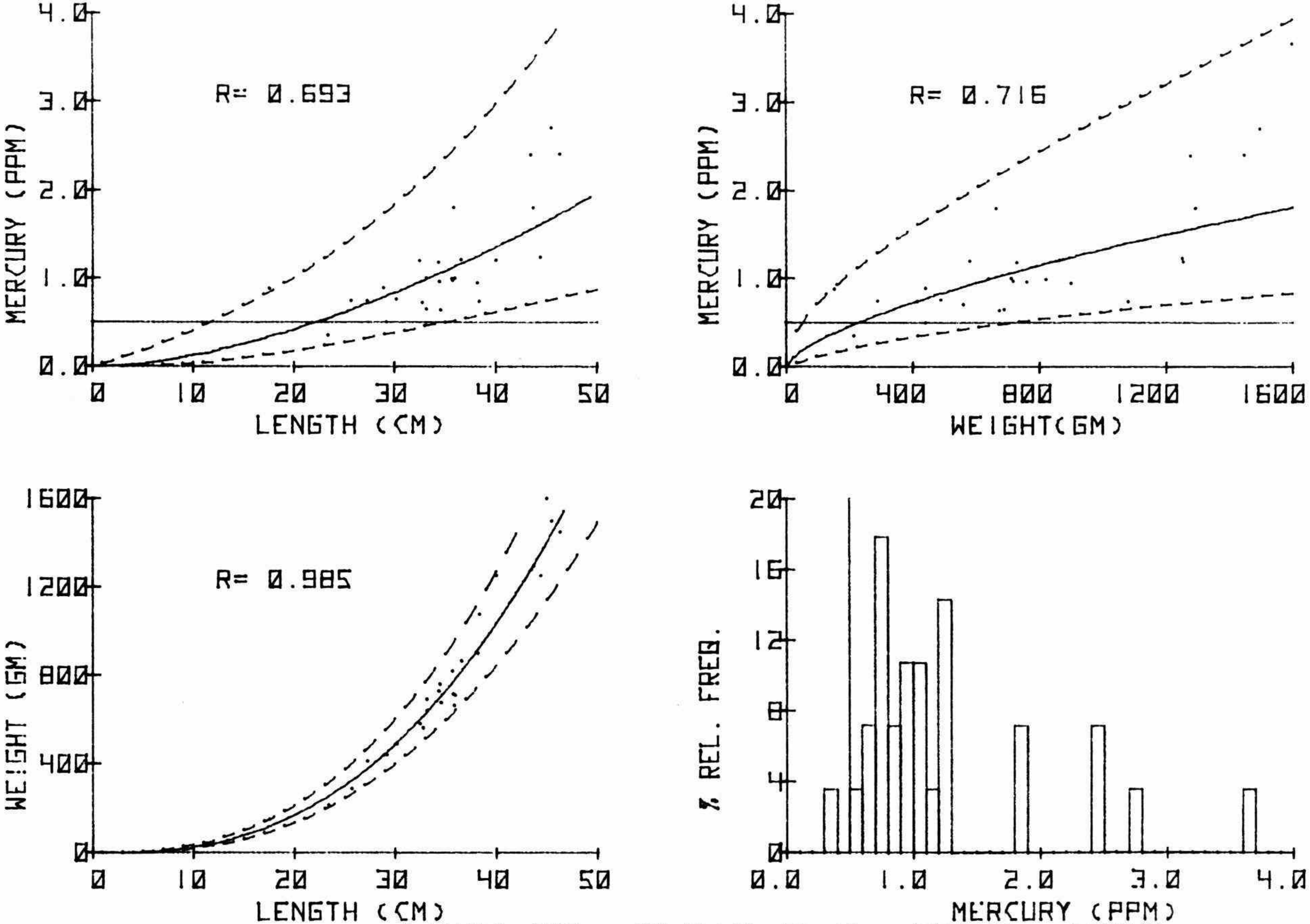
LAKE ST. CLAIR PIKE, 1976

FIGURE 8



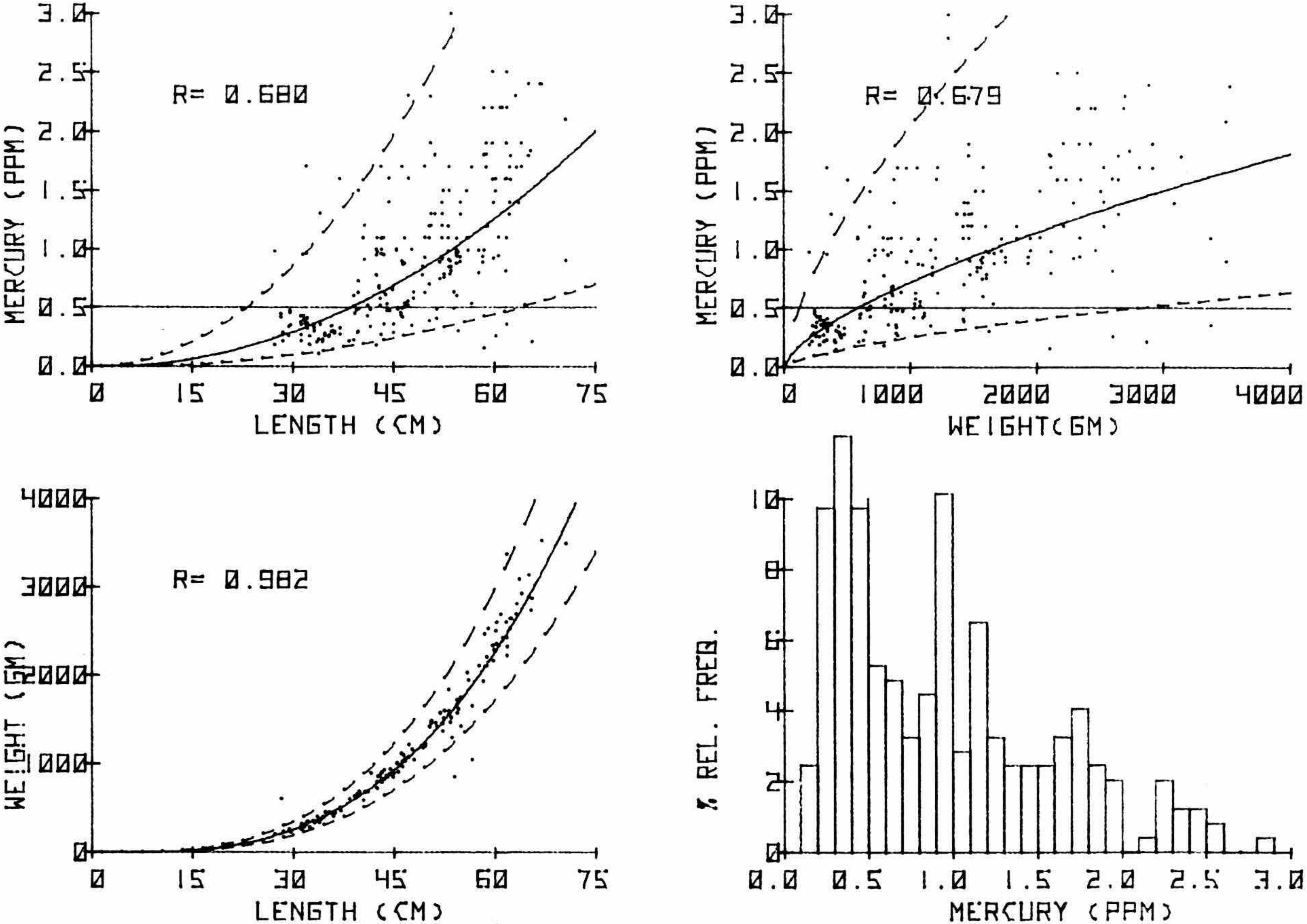
LAKE ST. CLAIR R. BASS, 1976

FIGURE 9



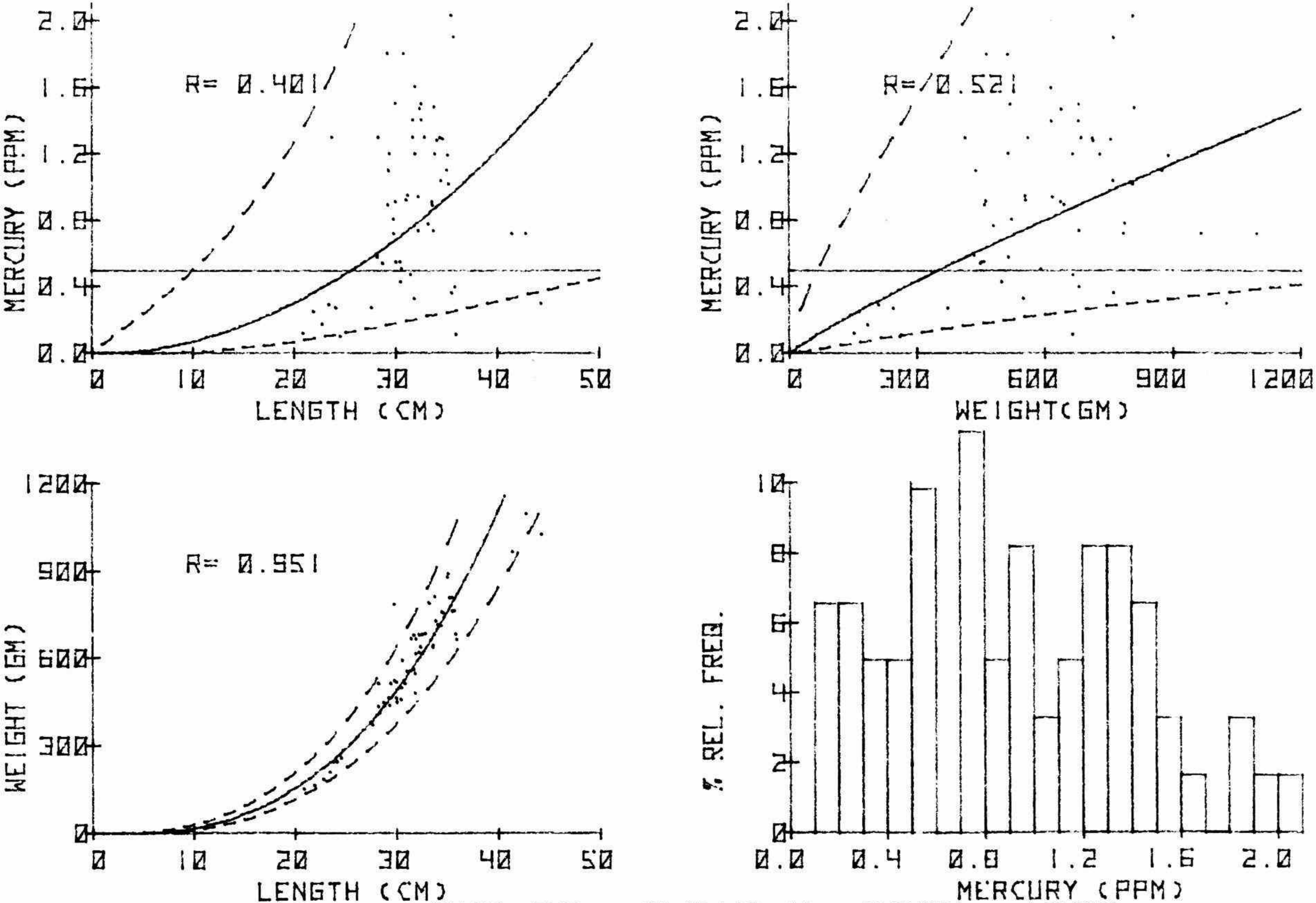
LAKE ST. CLAIR S.M. BASS, 1976

FIGURE 10



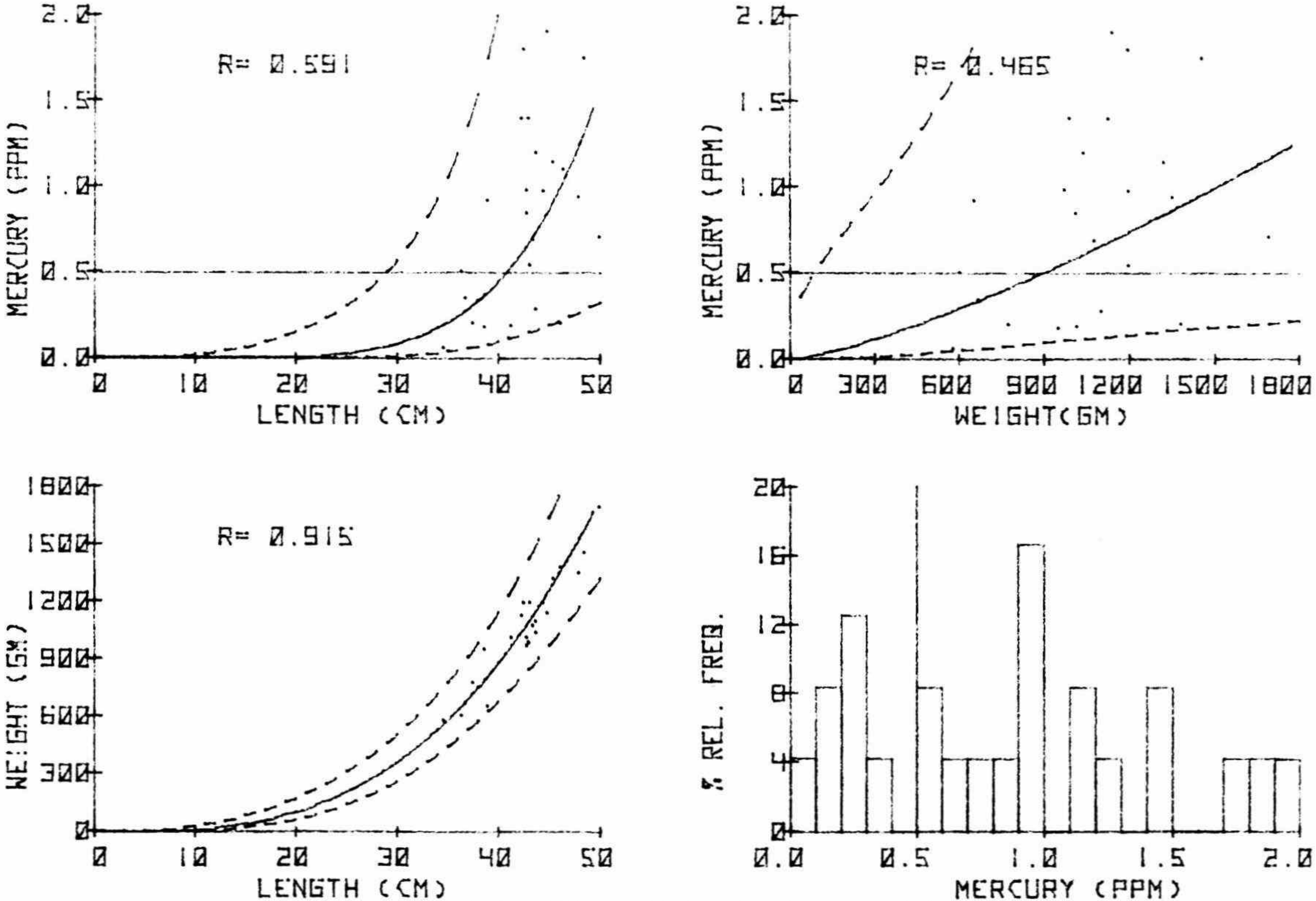
LAKE ST. CLAIR WALLEYE, 1976

FIGURE 11



LAKE ST. CLAIR W. BASS, 1976

FIGURE 12



LAKE ST. CLAIR W. SUCKER, 1976

c) Declining Mercury Concentrations

For several of the key species from Lake St. Clair, there was sufficient data from 1970 to 1976 to allow a comparison in the mercury concentrations over the years. As noted previously, the mercury concentration is correlated to fish size. Valid comparisons from year to year, therefore, should be done only between fish of equal length or weight. To do this, regressions were done for each of the species for each year for which sufficient data base was available. The estimate of the mercury concentration at a particular length or weight from the geometric regression, for each year was then plotted (see Figures 13 to 19).

Figure 13: Declining Mercury Levels in Carp from Lake St. Clair

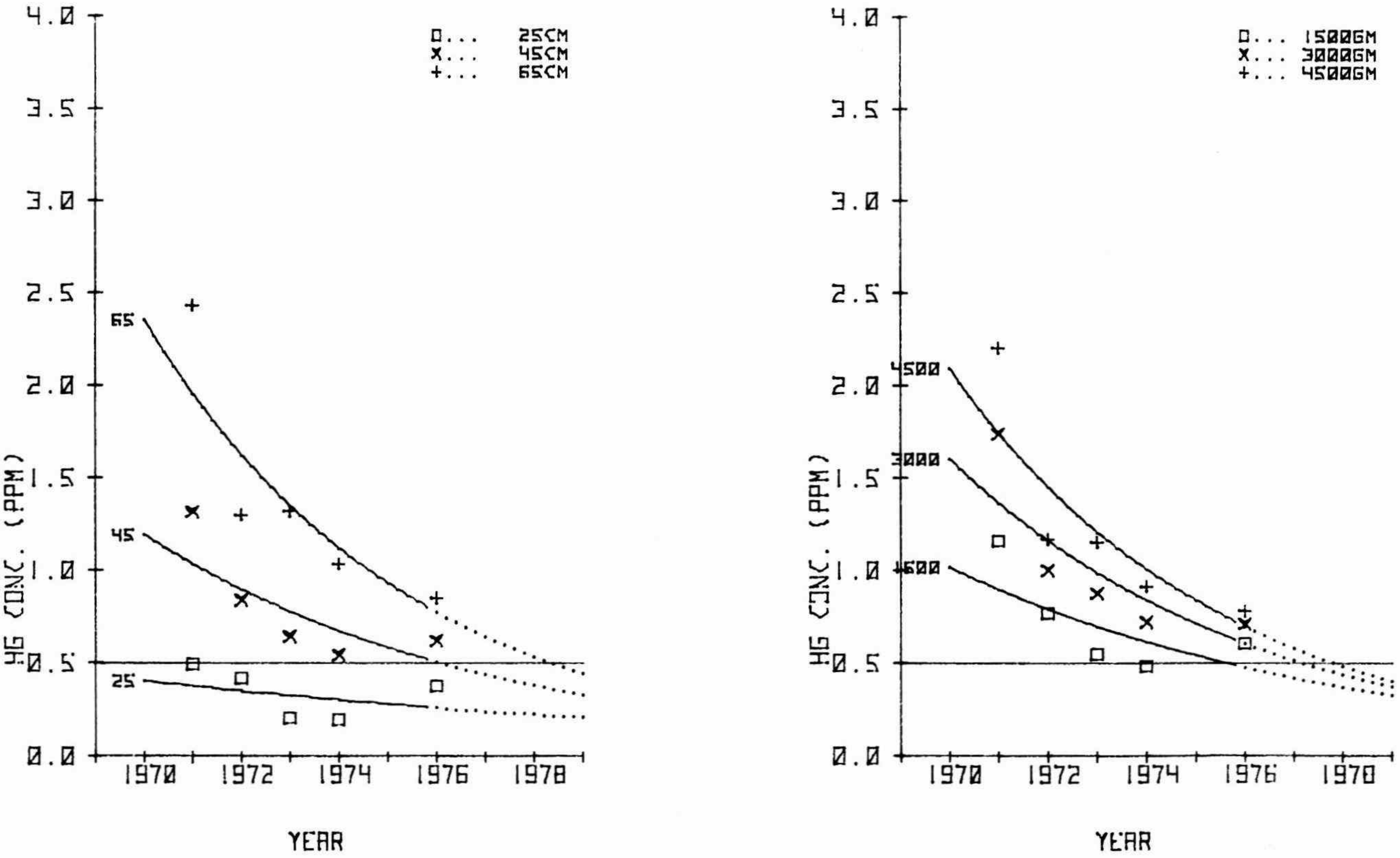
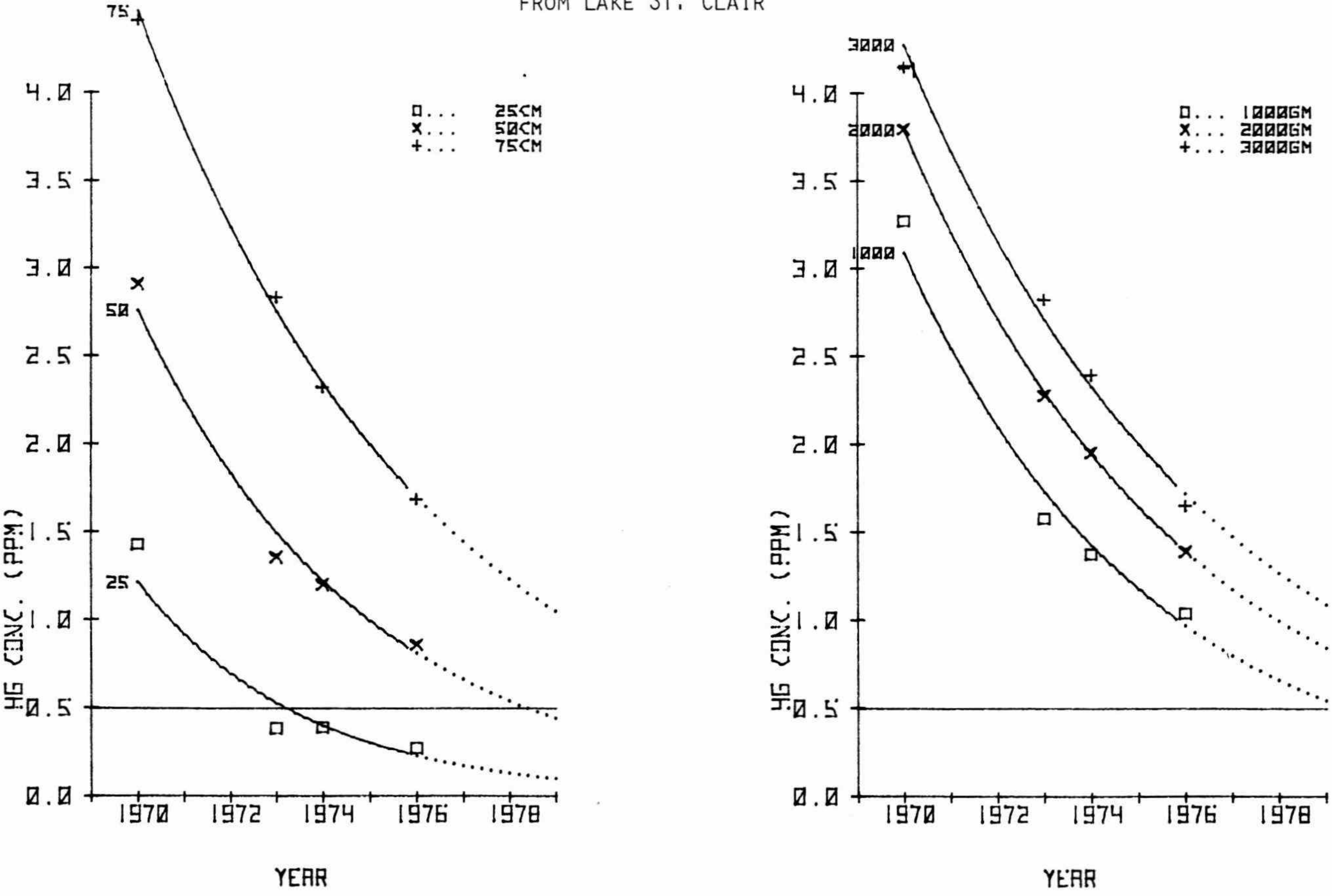


FIGURE 14: DECLINING MERCURY LEVELS IN PIKE FROM LAKE ST. CLAIR



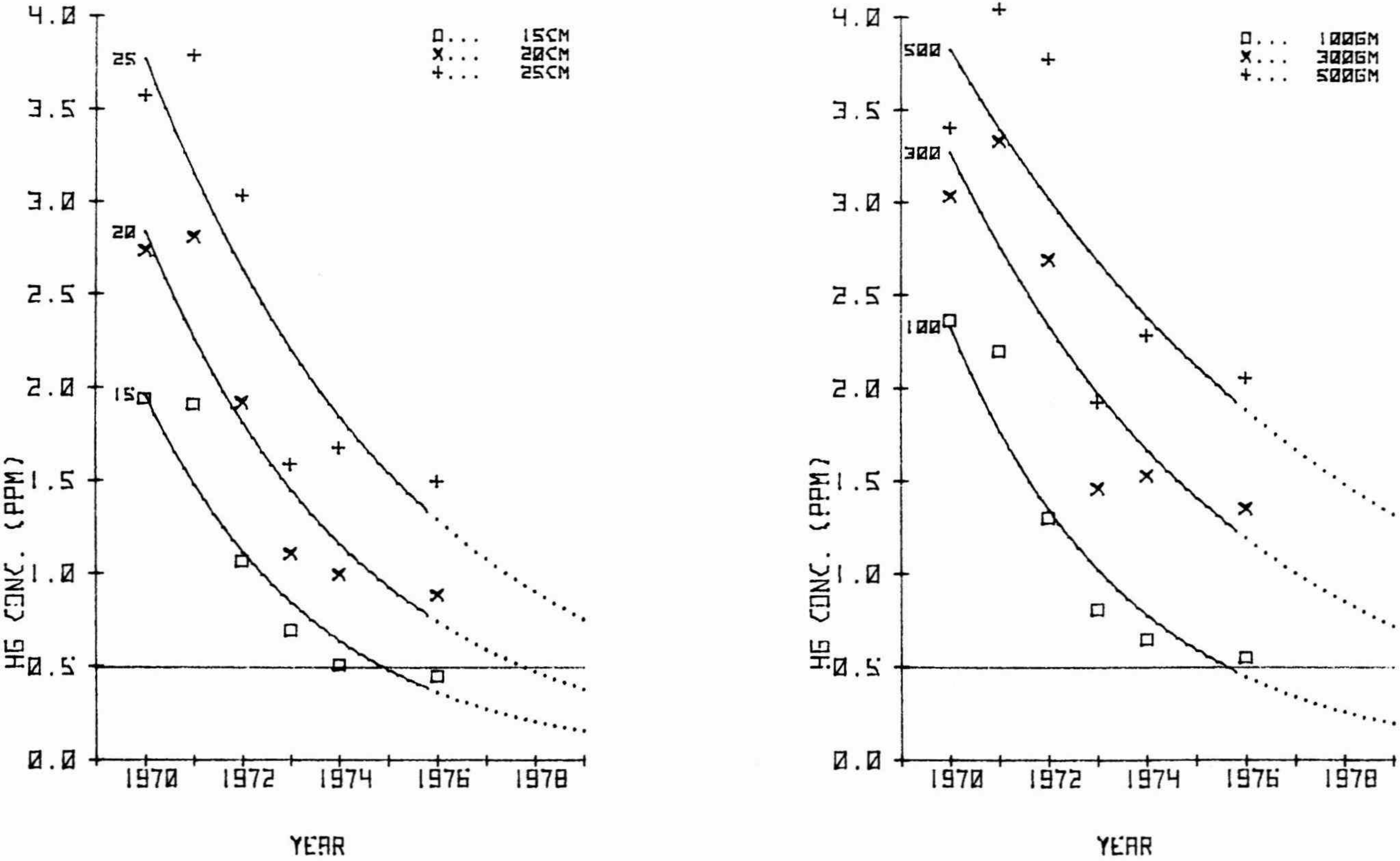


FIGURE 15: DECLINING MERCURY LEVELS IN ROCK BASS FROM LAKE ST. CLAIR

FIGURE 16: DECLINING MERCURY LEVELS IN SMALLMOUTH BASS FROM LAKE ST. CLAIR

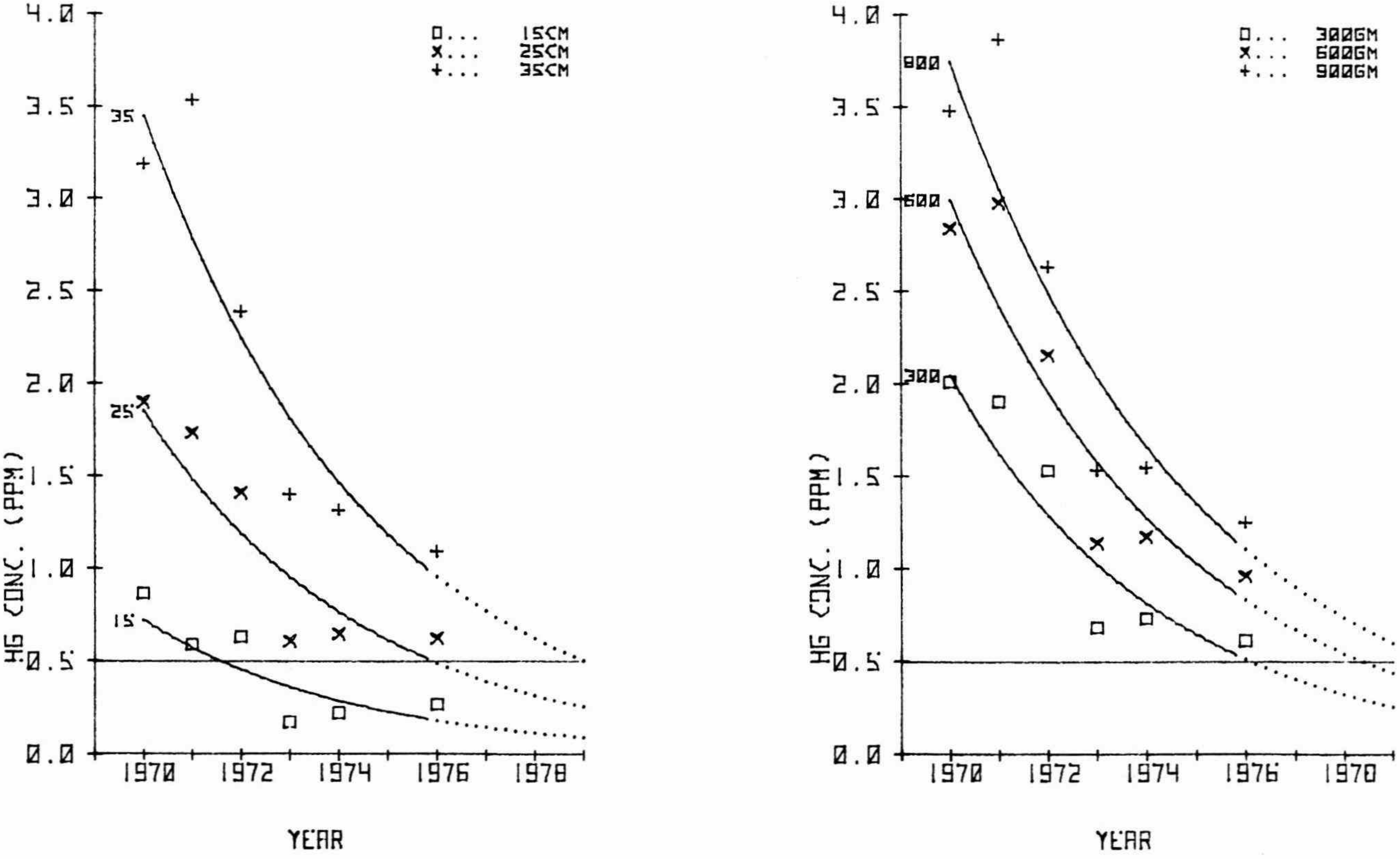


FIGURE 17: DECLINING MERCURY LEVELS IN WALLEYE FROM LAKE ST. CLAIR

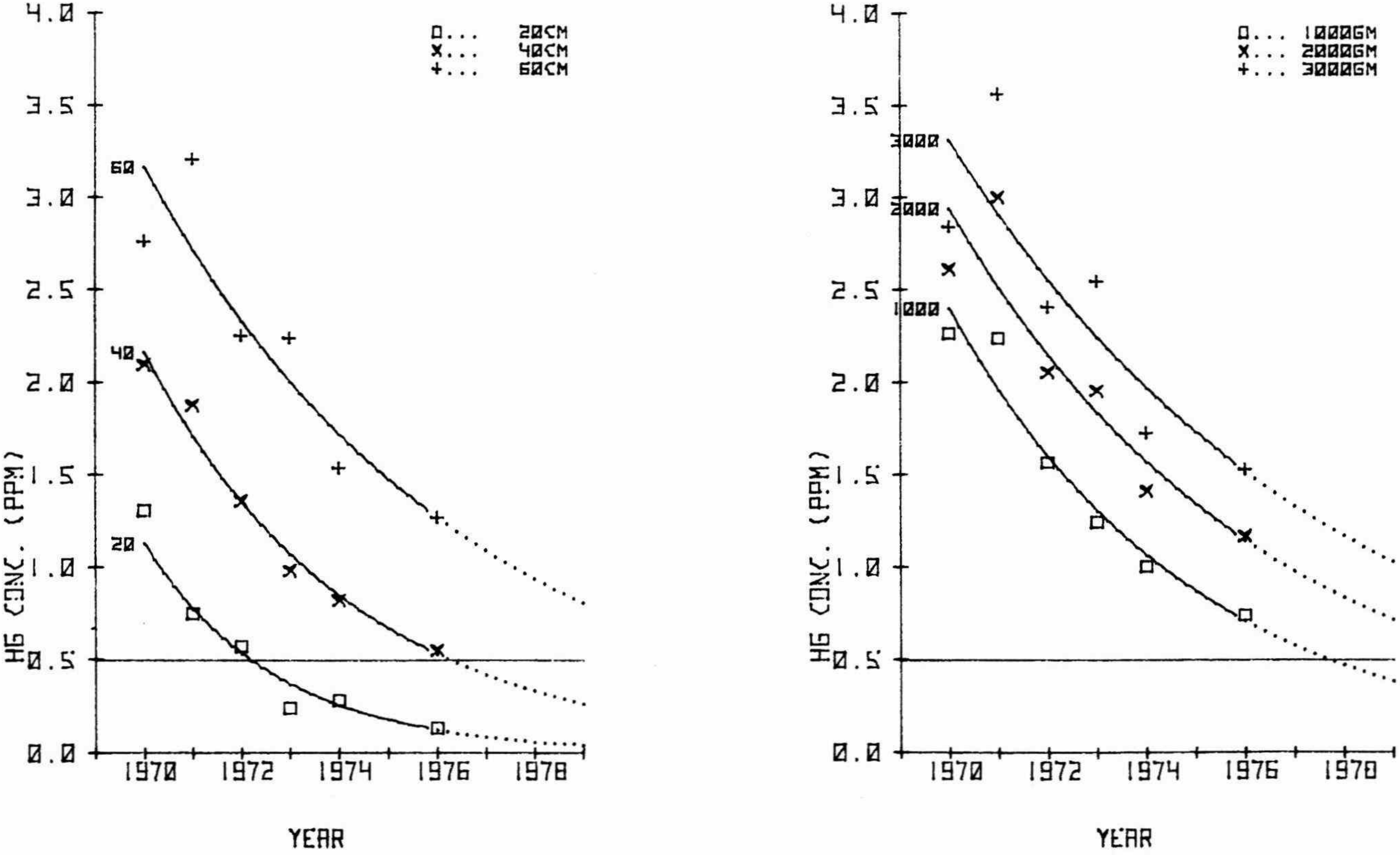


FIGURE 18: DECLINING MERCURY LEVELS IN WHITE BASS FROM LAKE ST. CLAIR

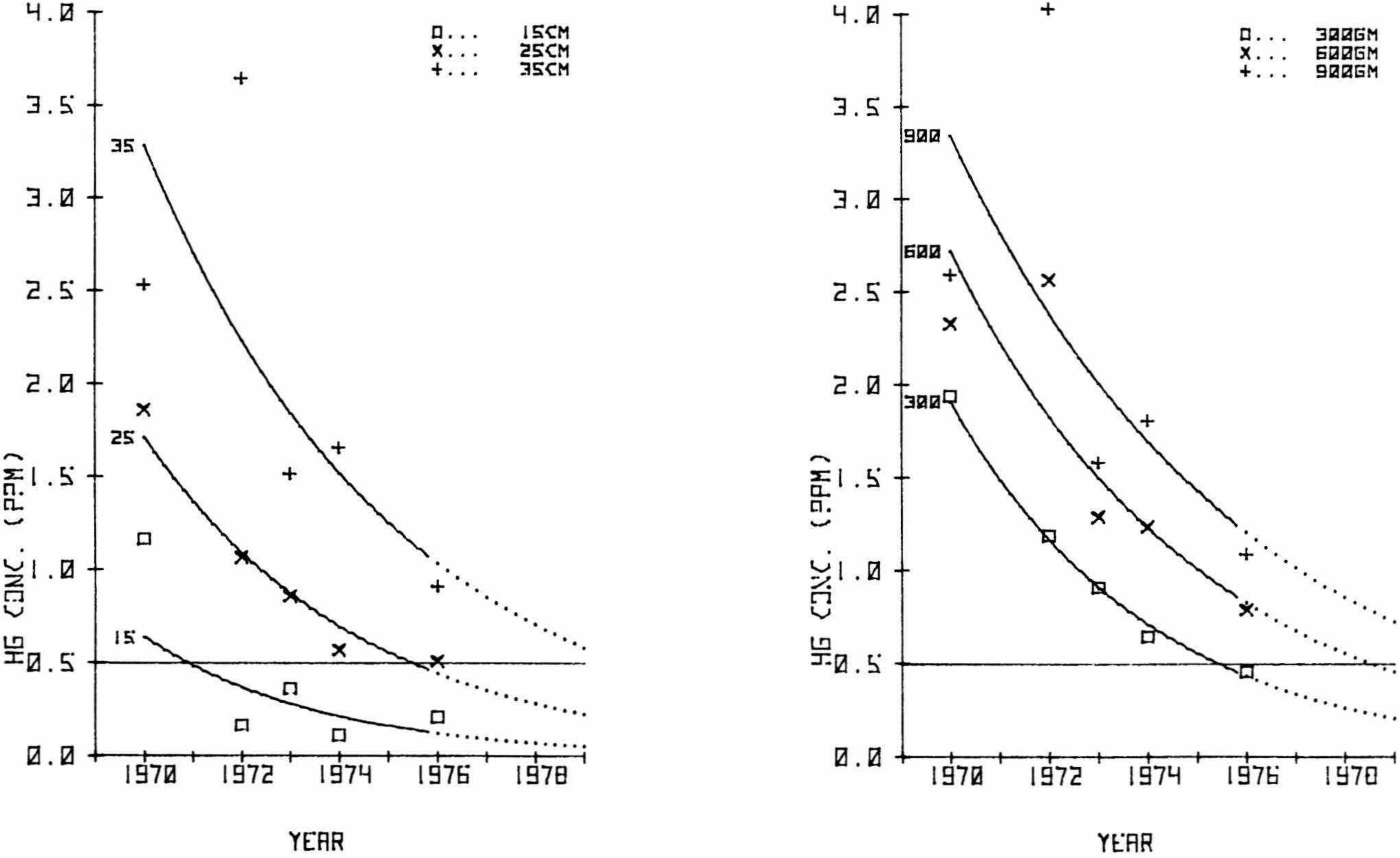
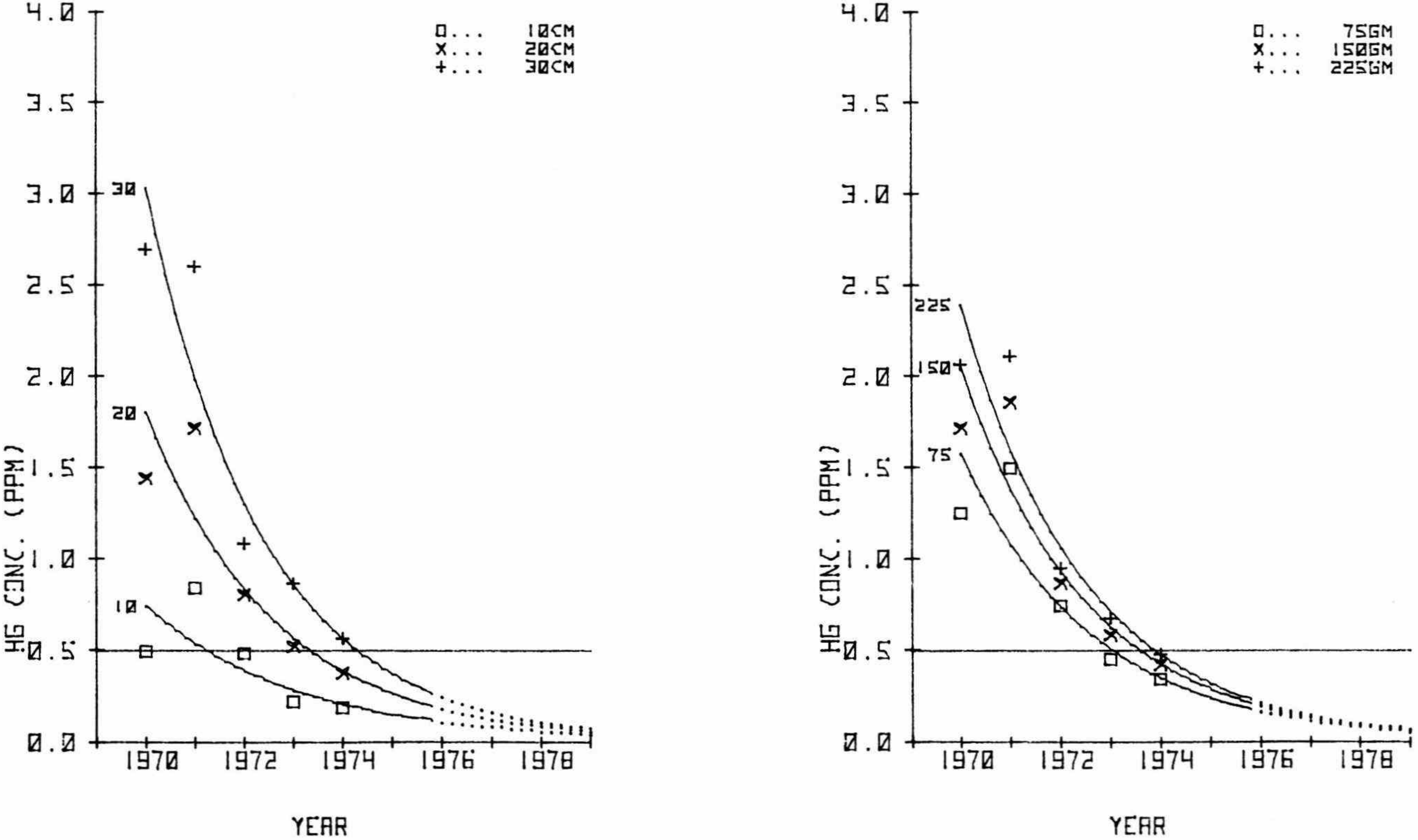


FIGURE 19: DECLINING MERCURY LEVELS IN YELLOW PERCH FROM LAKE ST. CLAIR



Discussion

a) Mercury Data Summaries

An examination of the summaries (Tables 2 to 8) indicates several trends in mercury concentration. For each species, there are general declines in average mercury concentration, in the maximum mercury concentrations, and in the percent of the sample exceeding 0.5 ppm.

Figures 20 to 22 graphically represent these trends for walleye, the species for which the largest annual data base is consistently available. For reasons referred to earlier, the data from 1975 has been omitted.

The data summaries also show that the number of specimens representing each species varies considerably from year to year and that the number of species represented also varies. Those species for which there are good yearly data bases are: carp, pike, rock bass, smallmouth bass, walleye, white bass, and yellow perch (up to 1974). For any given year, the level of mercury is highest in species at the top of the food chain (e.g. pike, smallmouth bass, muskie, rock bass, walleye), and is lower for benthic feeding fish (carp, white sucker, channel catfish).

b) Regressions

From Figures 4 to 12, it can be seen that the relationship between fish weight and fish length is highly correlated for all species, but the relationships between mercury concentration and fish size are not as well defined. This is partly due to the lack of differentiation between the sexes (see section on "Mercury concentration as a function of fish size"). Also, the relationship between mercury concentration and fish length usually has a higher correlation coefficient than the relationship between mercury and weight. It also appears that the predacious species (walleye, rock bass, smallmouth (bass,pike) generally have a more clearly defined mercury-size relation that those found for predominantly bottom feeding species (channel catfish, carp, white sucker).

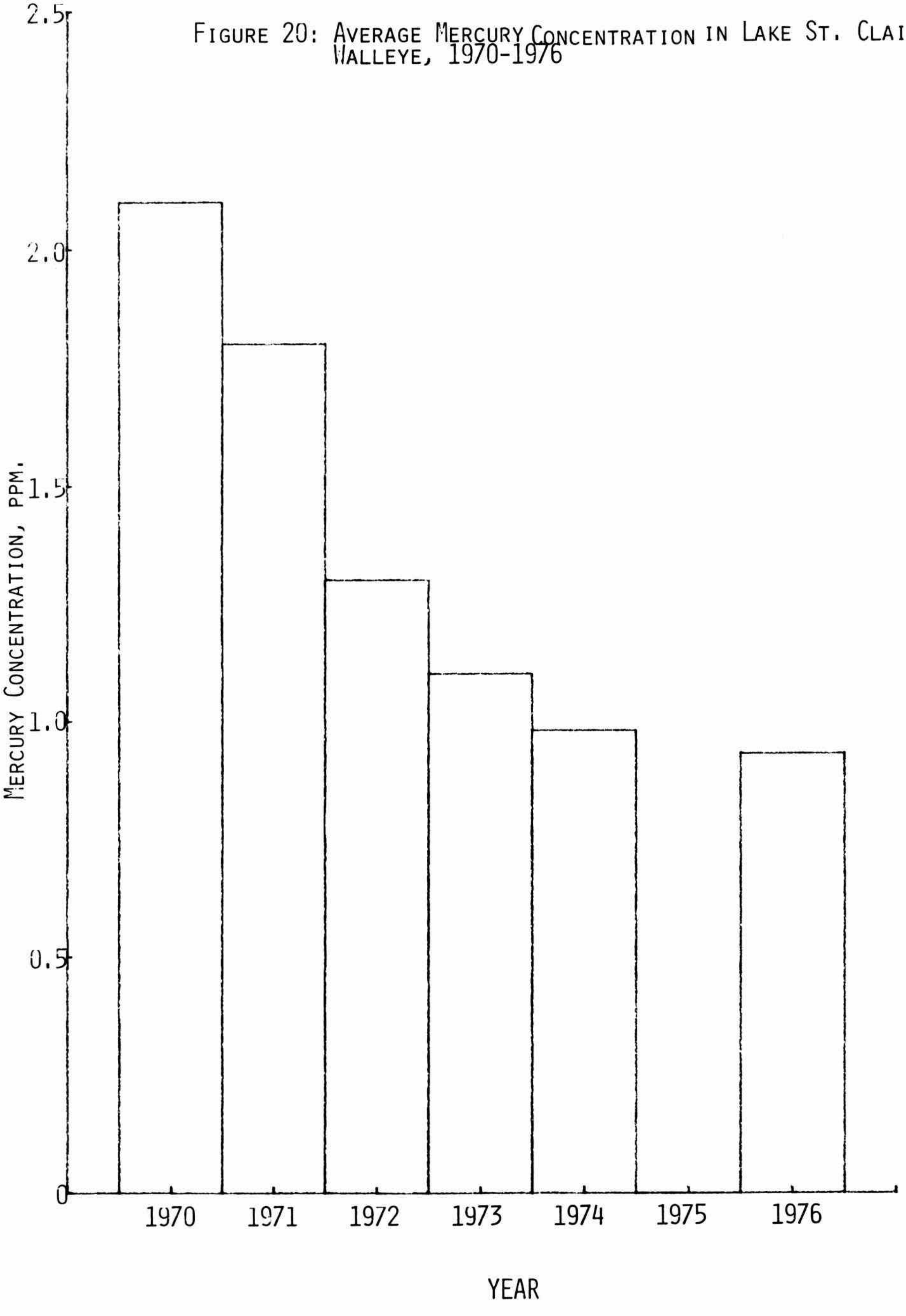


FIGURE 20: AVERAGE MERCURY CONCENTRATION IN LAKE ST. CLAIR WALLEYE, 1970-1976

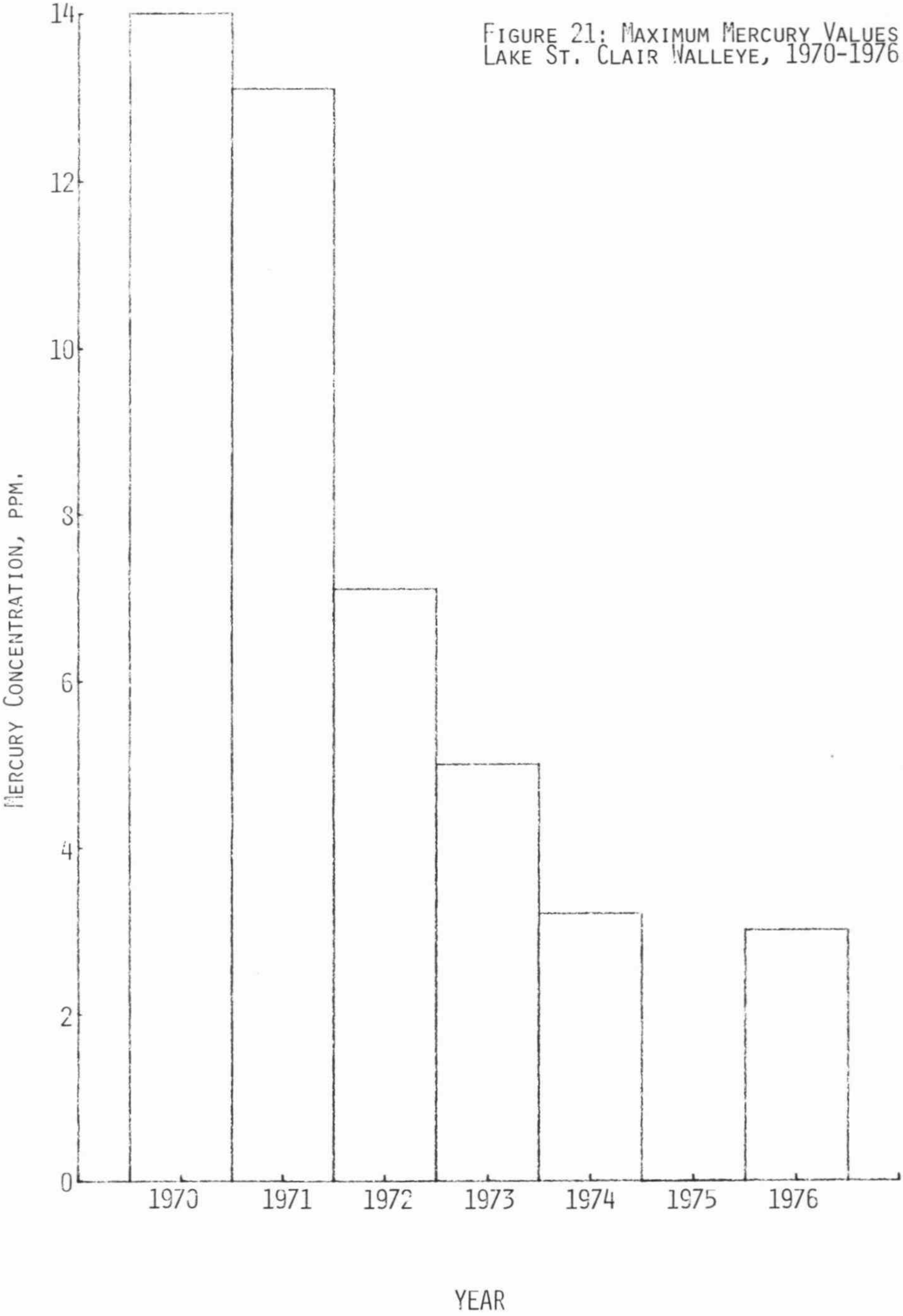


FIGURE 21: MAXIMUM MERCURY VALUES IN LAKE ST. CLAIR WALLEYE, 1970-1976.

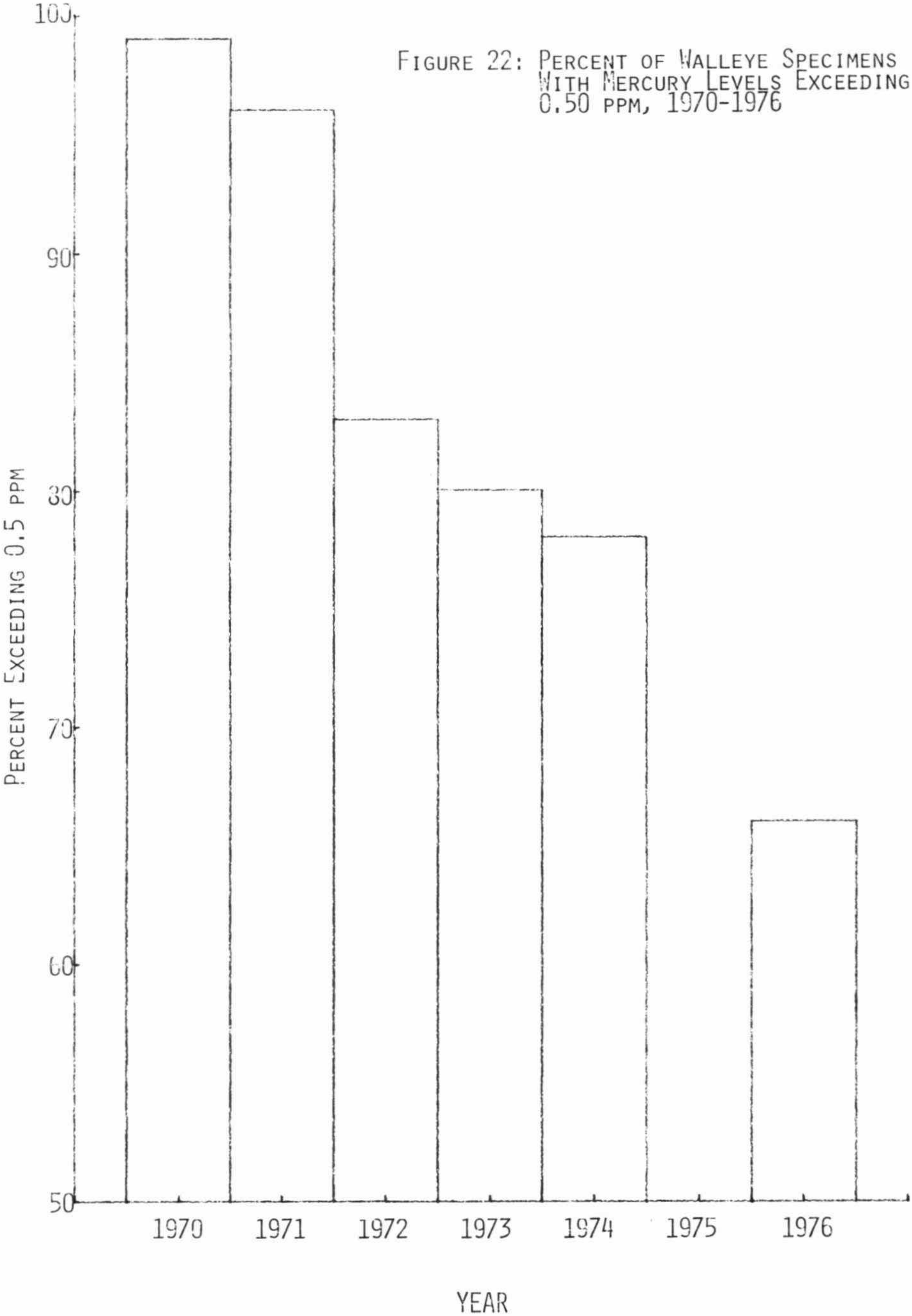


FIGURE 22: PERCENT OF WALLEYE SPECIMENS WITH MERCURY LEVELS EXCEEDING 0.50 PPM, 1970-1976

c) Declining Mercury Concentrations in Fish

The plots of the estimated mercury concentrations for a specified length or weight of several species of fish (figures 13 to 19) indicate definite tendencies towards lower mercury levels. For example, a 40 cm walleye in 1970 had a mean mercury level of 2.1ppm; in 1976 the level for the same sized walleye had fallen to 0.56 ppm. Similar observations can be made for all of the species examined at various sizes.

Another way of examining the loss of mercury is to compare the mean mercury level for a given year class of fish for a specified year, to the mercury level for the next subsequent year class in the next subsequent year. For example, the estimated mercury level in one-year old walleye in 1970 was 1.6ppm. In 1971, these walleyes would be two years old. Two year old walleye in 1971 had 1.55 ppm mercury. In 1972, three-year old walleye had an estimated 1.37 ppm mercury.

The mean lengths for each year class of walleye were derived from the 1973 collection for which age data was available (see figure 24). By plotting age against length for the large 1973 sample, an estimate was made of the approximate length for a given year class. This length data, now associated with a specific year class, was used to calculate the mean mercury concentration from the existing regression lines between fish length and mercury concentration, thereby providing an approximation of the mercury concentration associated with a given year class of fish, for any specified year. Figure 25 shows the decreasing mercury levels for the 1970 year class in subsequent years.

This approach indicates that in individual fish, the mercury concentration has, in fact declined from 1970 to 1976. The dilution of mercury concentration by fish growth indicates that the mercury contamination in the water and in the fish food chain has been curtailed.

The reduction in mercury concentration in individual fish, coupled with recruitment of new, relatively uncontaminated, year classes into the walleye population as a whole, has resulted in the dramatic over-all decline in the mean mercury level of walleye. While data was insufficient to perform this kind of analysis on other species of fish, it is reasonable to assume that similar processes occurred for the other species as well.

FIGURE 24: LENGTH OF WALLEYE AS A FUNCTION OF AGE.

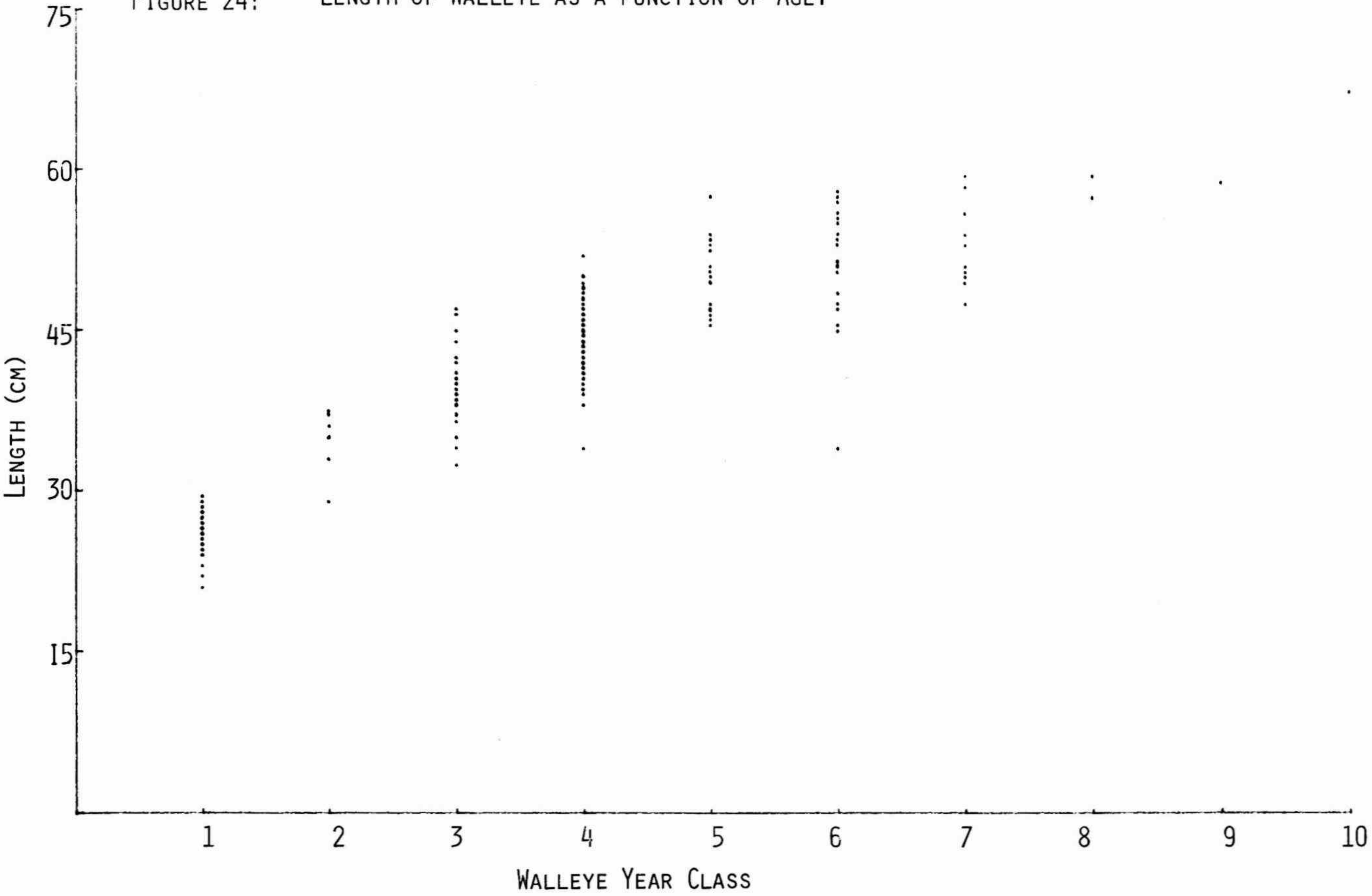
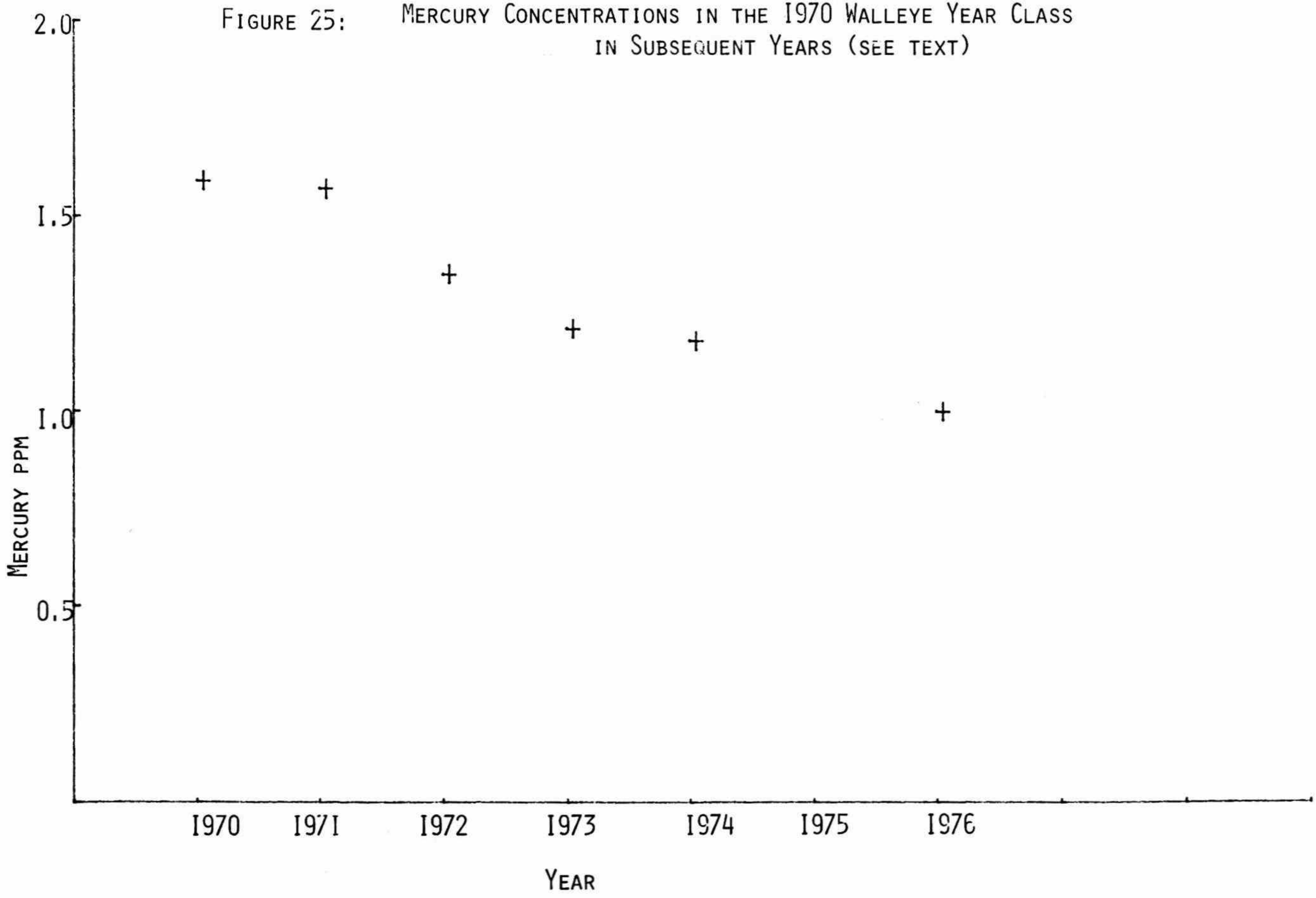


FIGURE 25: MERCURY CONCENTRATIONS IN THE 1970 WALLEYE YEAR CLASS IN SUBSEQUENT YEARS (SEE TEXT)



d) Extrapolation of Trends in Mercury Levels

The actual decline of mercury concentration in the species examined can be estimated by extrapolating the exponential decline curves. These curves are shown as figures 13 to 19 and show the geometric mean of different lengths and weights of each species from 1970 to 1976. These points have been approximated with an exponential decline curve fitted by the method of least squares. In general the correlation coefficients of the curves exceed 0.9, indicating that the exponential model is a reasonable approximation to the actual decline.

Besides indicating the dramatic decline in mercury concentrations for similar sizes of fish, the curves can be extrapolated beyond 1976, to predict when the geometric mean of the mercury concentration of a particular length or weight for each species will fall below the 0.5 ppm federal guideline.

Table 9 lists the species examined from this viewpoint and the year that the geometric mean of the mercury concentration for the average length (from 1976 length data) will fall below the 0.5 ppm guideline.

TABLE 9

AVERAGE LENGTHS OF FISH (1976) AND THE ESTIMATED YEAR BY WHICH THE GEOMETRIC MEAN MERCURY LEVEL OF THESE FISH WILL BE BELOW 0.5ppm.

SPECIES	MEAN LENGTH (cm)	YEAR
Carp	54	1977
Pike	68	1983
Rock Bass	21	1978
Smallmouth Bass	35	1979
Walleye	47	1978
White Bass	32	1979
Yellow Perch	22	1974

It should be noted that these predictions are based on the geometric mean, not the average mercury concentration for each species. Figures 9-13 show that the mercury concentrations are log normally distributed, so that the geometric mean yields a better estimate of the central tendency of the data than the average does.

For specimens larger than the average lengths indicated in Table 9, the time required for such fish to reach mercury concentrations below 0.5 ppm will be longer.

The conclusions derived from this approach are subject to several qualifications. Each point used in describing the exponential decline is derived from a regression between mercury concentration and fish length or weight. As is seen in Figures 4 to 12, these relationships are sometimes rather poorly defined, which leads to some degree of uncertainty about each point. A more satisfying approach would have been to use the upper 95% prediction limits in deriving the decline curves, but these limits are a function of the yearly sample size, and give no consistent pattern. From an examination of the exponential decline curves, it can be seen that there was sometimes an increase in mercury concentration in some of the larger sizes of fish from 1970 to 1971. This rise is attributed to the readily available mercury reserve in the water, sediment, and the lower end of the food chain which provided sufficient methylmercury to raise the levels in the larger fish. This has an effect on the formulation of the exponential curve, and cannot be accounted for by a simple exponential regression.

Observations on mercury concentrations in fish populations from Lake Huron indicate that there will always be a residual mercury content in fish from Lake St. Clair due, presumably, to natural sediment mercury levels. The exponential decline approach assumes that the rate of decline observed so far will continue, whereas it is probably more reasonable to assume that the mercury levels will not fall below those observed in fish from adjacent waters (such as Lake Huron). The Lake Erie population is not a reliable background since it has suffered from the effects of mercury inputs from the St. Clair and Detroit Rivers. The exponential curves, therefore, may be predicting a decline to unrealistically low mercury levels.

Despite these qualifications, the exponential decline model is a good approximation to the trends observed so far, and is of use in predicting when the geometric mean of the mercury concentration of a population of fish of similar size will fall below the federal guideline of 0.5ppm.

e) Reasons for the Decline

The major reason for the decline in mercury concentrations in Lake St. Clair fish is the cessation of mercury discharge from the Dow chlor-alkali plant in Sarnia. Since early 1970, the discharge of mercury was reduced from about 30 lb/day to a few ounces per day and subsequently reduced further when the plant switched to a diaphragm cell process. When the plant used mercury much of the mercury was probably discharged as soluble forms (most likely as mercury-chloride complexes). It has been shown that ionic mercury compounds are much more easily methylated by microorganisms than nonionic forms. It is reasonable to assume, therefore, that sometime between 1970 and 1972 there was a drastic reduction of the amount of readily biotransformable forms of mercury. Since that time, the rate of methylmercury biosynthesis has been so reduced that the rate of mercury accumulation by fish is exceeded by the growth rate of the fish. The net result is that the mercury level in fish has declined over the last seven years.

The mercury that was discharged in insoluble forms has been incorporated into the bottom sediments of the system. Sediment surveys in 1970 revealed a distribution of mercury down the Canadian shore of the St. Clair River, down the Detroit River, and extending into western Lake Erie as a plume from the Detroit River. Analysis of the various sediment size fractions showed mercury to be associated with the mobile, fine grain size particles. In the shallow water environment that characterizes Lake St. Clair and the western basin of Lake Erie, sediments are readily translocated by wave generated currents. Thomas (125) compared 1970 and 1974 mercury concentrations in the sediments of Lake St. Clair and concluded that 64% of the 1970 quantity had been transported downstream to Lake Erie. In a previous paper (126), Thomas had indicated that mercury inputs to Lake Erie would probably move through the shallow western and central basins to the deep eastern basin.

In conclusion, it is the cessation of the discharge of readily biotransformable forms of mercury to Lake St. Clair in combination with the transport of mercury contaminated sediments from the lake that has resulted the dramatic decline in mercury levels in fish from Lake St. Clair. The observed rate of decline is much more rapid than the 100 years estimated by earlier mercury researchers (130, 131) as the time required for natural processes to decontaminate a mercury - polluted ecosystem.

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APPENDIX I

Total and Methylmercury Analytical Methods.

Total Mercury Analysis

1976 to Present

Sample aliquots of 0.2 to 0.5 g of homogenized epaxial muscle are weighed into tared Pyrex culture tubes. Five ml of a mixture of 75% H_2SO_4, 25% HNO_3 are added, and the tubes are placed in an aluminum block with holes drilled 1⅓" deep, to accomodate the tubes. The block is placed on a hot plate and the samples are heated to 260°C until continuous white fuming occurs (3-4 hours). After cooling, the solution is transferred to a 25 ml calibrated tube, and distilled water is added to make the volume up to 25 ml.

The tubes are then placed in an automatic sampler, which samples an aliquot, reacts it with a reductant solution consisting of 200 ml. distilled water, 100 ml. concentrated hydrochloric acid, 40g stannous chloride, 20g hydroxylamine sulfate, and 10g sodium chloride, made to 1 l. with distilled water. This solution converts the mercuric ions to atomic mercury which is sparged by an air stream into an absorption cell where the concentration of mercury is measured by atomic absorption of UV light at 253.7 nm using an LDC mercury monitor.

1973 to 1975

The same digestion procedure as is described above was used, but the automatic sampler was not used. After digestion and cooling, enough 6% $KMnO_4$ solution was added to obtain a persistent purple colour. After cooling again, 20 ml. of distilled water were added, as was enough of a 20% hydroxylamine sulfate solution to reduce the excess potassium permanganate solution. The solution was then transferred to a drechsel bottle, and the volume adjusted to 50 ml. with distilled water. Three ml. of 20% stannous chloride was added, and the mercury vapour was swept from solution and into the LDC for measurement.

1970 to 1973

From 1970 to 1971, a variety of analytical procedures were evaluated. Generally they consisted of wet digestions using oxidizing acids and elevated temperatures. Sulfuric-nitric mixtures, nitric-perchloric mixtures, and other acid-oxidant mixtures were evaluated.

By early 1970, the laboratory used a 58°C open system, sulfuric-nitric acid digestion (27). The temperature was increased to 80°C with no apparent loss of mercury, corroborating the work of Lindstedt (28). Powerful oxidants like vanadium pentoxide and hydrogen peroxide were used (29). These modifications were made in order to fully digest the fish tissue, including refractory lipids, and yet not volatilize the mercury released from the tissue. The principal method developed by late 1970 began with 0.3 to 0.5 g of homogenized fish tissue being injected into a tared 30 ml micro-kjeldahl flask with an all glass plunger device (27). Five ml of 80% H_2SO_4 , 20% HNO_3 were added, and the flasks were placed in clamps in an oscillating water bath at 80°C for four hours. When the solutions were clear, they were cooled, removed, and a saturated $KMnO_4$ solution was added until a persistent purple colour was obtained. An additional five ml of the saturated permanganate solution were then added, and the flasks were replaced in the water bath (80°C) for another 1.5 hours. The flasks were then removed and allowed to cool overnight.

The reduction-aeration was performed as described above, and the mercury vapour was measured using a Hilger-Watts Atomspek Atomic absorption spectrophotometer set at 253.7nm.

Methylmercury Analysis

One gram of homogenized fish tissue was weighed into a 25 ml screw-cap culture tube, and 5 ml of distilled water was added. The sample was homogenized for 1 minute using a Polytron homogenizer, and the probe was rinsed down with another 5 ml. of distilled water. One ml of 25% $CuSO_4$ and 5 ml of 30% NaBr in 10% H_2SO_4 was added, the tube was capped with a teflon lined cap, and allowed to stand overnight in the dark. Ten ml of toluene were added, and the tubes were agitated for 2 minutes. The tubes were then centrifuged, and 5 ml of the toluene layer was transferred to a 10 ml graduated screw cap entrifuge tube. The toluene extract, 2 ml 0.01M $Na_2S_2O_3$ were added, the tubes were capped, agitated for 2 minutes, then centrifuged. The thiosulfate layer was removed, and transferred to another 10 ml screw-cap culture tube, and 2 ml of a 1M $CuBr_2$ solution was added. One ml of benzene was added, the tubes were capped and agitated for 1 minute. After centrifuging the benzene layer was analyzed for methylmercuric bromide on a Varian 1400 gas chromatograph, using a tritium electron capture detector. A 6', 1/8" i.d. glass column packed with 5% Carbowax 20M on NaBr impregnated Varaport 30 (100-120 mesh) was used.

APPENDIX II

REGRESSION COEFFICIENTS

SPECIES	REGRESSION*	A0**	AI	R
Black Crappie	W to L	0.0115	3.1634	0.958
	Hg to L	2.67×10^{-5}	3.1844	0.713
	Hg to W	4.49×10^{-3}	0.8910	0.659
Carp	W to L	0.0285	2.9181	0.976
	Hg to L	0.0210	0.8877	0.288
	Hg to W	0.0862	0.2632	0.255
Channel Catfish	W to L	0.019	2.9277	0.975
	Hg to L	0.0673	0.5971	0.284
	Hg to W	0.2117	0.1597	0.228
Pike	W to L	0.0022	3.2718	0.9834
	Hg to L	1.04×10^{-3}	1.7135	0.457
	Hg to W	0.0554	0.4238	0.376
Rock Bass	W to L	0.0428	2.7840	0.977
	Hg to L	6.33×10^{-4}	2.4087	0.656
	Hg to W	0.0128	0.8123	0.630
Smallmouth Bass	W to L	0.727	2.5930	0.985
	Hg to L	2.97×10^{-3}	1.6623	0.693
	Hg to W	0.0148	0.6525	0.716

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SPECIES	REGRESSION	A0**	AI	R
Walleye	W to L	0.0082	3.0602	0.982
	Hg to L	2.80×10^{-4}	2.0568	0.680
	Hg to W	0.077	0.6598	0.679
White Bass	W to L	0.0344	2.8132	0.951
	Hg to L	7.78×10^{-4}	1.9954	0.401
	Hg to W	0.0029	0.8769	0.521
White Sucker	W to L	0.0111	3.0569	0.915
	Hg to L	0.000	5.6388	0.591
	Hg to W	6.00×10^{-5}	1.3292	0.465

* W to L = Weight (gm) to Length (cm) regression
Hg to L = Mercury(ppm) to Length (cm) regression
Hg to W = Mercury (ppm) to Weight (gm) regression

** All coefficients are given on the basis of the model

$$Y = A0\ x^{AI}$$

and R is the corresponding correlation coefficient.

APPENDIX III

RAW DATA FOR 1976

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 0

#		SPECIES	HG	LENGTH	WEIGHT
BR	2840	WALLEYE	1.20	40.7	680
BR	2841	WALLEYE	0.27	31.3	320
BR	2842	WALLEYE	0.23	34.4	400
BR	2843	WALLEYE	0.41	32.2	347
BR	2844	WALLEYE	0.36	45.0	890
BR	2845	R. BASS	0.77	17.8	124
BR	2846	R. BASS	1.20	21.8	215
BR	2847	R. BASS	0.23	16.9	119
BR	2848	R. BASS	0.47	17.9	140
BR	2849	R. BASS	0.61	21.2	230
BR	2850	R. BASS	0.89	22.0	235
BR	2851	R. BASS	0.68	20.3	185
BR	2852	R. BASS	0.74	20.5	180
BR	2853	W. BASS	0.17	22.8	185
BR	2854	Y. PERCH	0.78	25.9	249
BR	2855	S.M. BASS	0.72	32.8	560
BR	2856	S.M. BASS	2.40	46.3	1447
BR	2857	W. SUCKER	0.69	43.4	1075
BR	2858	CARP	0.27	53.8	3785
BR	2859	C. CATFISH	0.66	52.2	1875
BR	2860	C. CATFISH	0.77	60.9	3624
BR	2861	C. CATFISH	0.50	60.5	3322
BR	2862	C. CATFISH	0.78	56.4	2630
BR	2863	C. CATFISH	0.66	54.0	1965
BR	2864	C. CATFISH	0.41	57.9	2476
BR	2865	WALLEYE	0.91	40.7	680
BR	2866	WALLEYE	0.22	31.3	320
BR	2867	WALLEYE	0.21	34.4	400
BR	2868	WALLEYE	0.34	32.2	347
BR	2869	WALLEYE	0.29	45.0	890
BR	2888	WALLEYE	0.85	53.2	1555
BR	2889	WALLEYE	0.69	42.9	867
BR	2890	WALLEYE	0.98	42.6	854
BR	2891	WALLEYE	0.76	52.5	1600
BR	2892	WALLEYE	0.51	46.7	1036
BR	2893	WALLEYE	0.36	33.2	340
BR	2894	WALLEYE	0.30	35.7	435
BR	2895	WALLEYE	0.96	32.1	345
BR	2896	WALLEYE	1.40	59.9	2290
BR	2897	WALLEYE	0.88	46.7	1065
BR	2898	WALLEYE	0.49	45.7	905
BR	2899	WALLEYE	0.99	45.5	1005
BR	2900	WALLEYE	1.00	54.4	1720
BR	2901	WALLEYE	1.70	58.8	2110
BR	2902	WALLEYE	2.20	61.9	2325
BR	2903	WALLEYE	0.52	47.2	1080
BR	2904	WALLEYE	0.58	48.0	1045
BR	2905	WALLEYE	0.95	42.5	725
BR	2906	WALLEYE	1.20	50.6	1485
BR	2907	WALLEYE	0.36	31.3	300

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 1

#		SPECIES	HG	LENGTH	WEIGHT
BR	2908	WALLEYE	0.78	49.3	1175
BR	2909	WALLEYE	0.92	52.2	1460
BR	2910	WALLEYE	1.50	53.3	1575
BR	2911	WALLEYE	1.10	50.4	1420
BR	2912	WALLEYE	1.20	52.2	1455
BR	2913	WALLEYE	0.38	31.2	265
BR	2914	WALLEYE	0.27	28.6	225
BR	2915	WALLEYE	0.35	29.6	230
BR	2916	WALLEYE	0.43	31.6	290
BR	2917	WALLEYE	0.46	29.6	245
BR	2918	WALLEYE	0.33	33.2	345
BR	2919	WALLEYE	1.70	62.3	2530
BR	2920	WALLEYE	1.30	55.0	1430
BR	2921	WALLEYE	1.10	53.2	1840
BR	2922	WALLEYE	2.20	59.7	2335
BR	2923	WALLEYE	2.30	50.6	1465
BR	2924	WALLEYE	0.79	53.4	1470
BR	2925	WALLEYE	0.89	58.3	1930
BR	2926	WALLEYE	0.68	44.9	855
BR	2927	WALLEYE	1.80	51.2	1460
BR	2928	WALLEYE	0.94	54.9	1750
BR	2929	WALLEYE	0.97	54.4	1665
BR	2930	WALLEYE	0.89	51.9	1570
BR	2931	WALLEYE	0.70	50.4	1425
BR	2932	WALLEYE	0.42	46.4	1100
BR	2933	WALLEYE	1.00	47.7	1160
BR	2934	WALLEYE	0.36	34.1	380
BR	2935	WALLEYE	1.60	61.7	2600
BR	2936	WALLEYE	0.82	53.6	1530
BR	2937	WALLEYE	0.80	57.7	2110
BR	2938	WALLEYE	0.94	54.5	1575
BR	2939	WALLEYE	0.41	51.5	1420
BR	2940	WALLEYE	0.63	49.7	1220
BR	2941	WALLEYE	1.90	58.8	2210
BR	2942	WALLEYE	1.00	56.2	1950
BR	2943	WALLEYE	1.10	49.7	1205
BR	2944	WALLEYE	0.98	54.6	1620
BR	2945	WALLEYE	0.34	41.6	895
BR	2946	WALLEYE	0.54	56.7	1655
BR	2947	WALLEYE	1.80	58.5	2100
BR	2948	WALLEYE	0.27	43.2	905
BR	2949	WALLEYE	1.60	47.2	1210
BR	2950	WALLEYE	2.10	70.6	3495
BR	2951	WALLEYE	0.90	46.3	970
BR	2952	WALLEYE	2.20	58.5	2465
BR	2953	WALLEYE	0.78	42.5	795
BR	2954	WALLEYE	0.23	39.1	635
BR	2955	WALLEYE	0.49	39.8	685
BR	2956	WALLEYE	1.50	52.4	1515
BR	2957	WALLEYE	1.60	59.8	2165

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 2

#		SPECIES	HG	LENGTH	WEIGHT
BR	2958	WALLEYE	3.00	53.7	1305
BR	2959	WALLEYE	0.99	53.2	1595
BR	2960	WALLEYE	1.10	43.2	825
BR	2961	WALLEYE	1.10	40.5	590
BR	2962	WALLEYE	1.90	64.0	2920
BR	2963	WALLEYE	1.80	62.5	2650
BR	2964	WALLEYE	0.40	31.9	320
BR	2965	WALLEYE	0.34	29.4	260
BR	2966	WALLEYE	0.91	53.2	1555
BR	2967	WALLEYE	0.67	42.9	867
BR	2968	WALLEYE	1.10	42.6	854
BR	2969	WALLEYE	0.79	52.5	1600
BR	2970	WALLEYE	0.54	46.7	1036
BR	2971	WALLEYE	0.36	33.2	340
BR	2972	WALLEYE	0.34	35.7	435
BR	2973	WALLEYE	1.70	32.1	345
BR	2974	WALLEYE	0.93	59.9	2290
BR	2975	WALLEYE	1.10	46.7	1065
BR	2976	WALLEYE	0.50	45.7	905
BR	2977	WALLEYE	1.00	45.5	1005
BR	2978	WALLEYE	1.10	54.4	1720
BR	2979	WALLEYE	1.80	58.8	2110
BR	2980	WALLEYE	2.50	61.9	2325
BR	2981	WALLEYE	0.56	47.2	1080
BR	2982	WALLEYE	0.63	48.0	1045
BR	2983	WALLEYE	1.00	42.5	725
BR	2984	WALLEYE	1.30	50.6	1485
BR	2985	WALLEYE	0.36	31.3	300
BR	2986	WALLEYE	0.85	49.3	1175
BR	2987	WALLEYE	1.10	52.2	1460
BR	2988	WALLEYE	1.70	53.3	1575
BR	2989	WALLEYE	1.20	50.4	1420
BR	2990	WALLEYE	1.40	52.2	1455
BR	2991	WALLEYE	0.43	31.2	265
BR	2992	WALLEYE	0.22	28.6	225
BR	2993	WALLEYE	0.35	29.6	230
BR	2994	WALLEYE	0.40	31.6	290
BR	2995	WALLEYE	0.47	29.6	245
BR	2996	WALLEYE	0.31	33.2	345
BR	2997	WALLEYE	1.40	62.3	2530
BR	2998	WALLEYE	1.40	55.0	1430
BR	2999	WALLEYE	1.20	53.2	1840
BR	3000	WALLEYE	1.90	59.7	2335
BR	3001	WALLEYE	1.90	50.6	1465
BR	3002	WALLEYE	0.91	53.4	1470
BR	3003	WALLEYE	0.94	58.3	1930
BR	3004	WALLEYE	0.66	44.9	855
BR	3005	WALLEYE	1.30	51.2	1460
BR	3006	WALLEYE	0.90	54.9	1750
BR	3007	WALLEYE	0.88	54.4	1665

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 3

#	SPECIES	HG	LENGTH	WEIGHT
BR 3008	WALLEYE	0.75	51.9	1570
BR 3009	WALLEYE	0.39	50.4	1425
BR 3010	WALLEYE	0.87	46.4	1100
BR 3011	WALLEYE	0.35	47.7	1160
BR 3012	WALLEYE	1.30	34.1	380
BR 3013	WALLEYE	0.82	61.7	2600
BR 3014	WALLEYE	0.86	53.6	1530
BR 3015	WALLEYE	0.99	57.7	2110
BR 3016	WALLEYE	0.60	54.5	1575
BR 3017	WALLEYE	0.49	51.5	1420
BR 3018	WALLEYE	1.70	49.7	1220
BR 3019	WALLEYE	1.20	58.8	2210
BR 3020	WALLEYE	1.10	56.2	1950
BR 3021	WALLEYE	0.93	49.7	1205
BR 3022	WALLEYE	0.31	54.6	1620
BR 3023	WALLEYE	0.49	41.6	895
BR 3024	WALLEYE	1.70	56.7	1055
BR 3025	WALLEYE	0.16	58.5	2100
BR 3026	WALLEYE	1.70	43.2	905
BR 3027	WALLEYE	2.30	47.2	1210
BR 3028	WALLEYE	0.91	70.6	3495
BR 3029	WALLEYE	1.70	46.3	970
BR 3030	WALLEYE	1.00	58.5	2465
BR 3031	WALLEYE	0.18	42.5	795
BR 3032	WALLEYE	0.60	39.1	635
BR 3033	WALLEYE	1.50	39.8	685
BR 3034	WALLEYE	1.50	52.4	1515
BR 3035	WALLEYE	2.50	59.8	2165
BR 3036	WALLEYE	2.80	53.7	1305
BR 3037	WALLEYE	1.20	53.2	1595
BR 3038	WALLEYE	0.96	43.2	825
BR 3039	WALLEYE	1.10	40.5	590
BR 3040	WALLEYE	1.70	64.0	2920
BR 3041	WALLEYE	1.60	62.5	2650
BR 3042	WALLEYE	0.37	31.9	320
BR 3043	WALLEYE	0.26	29.4	260
BR 3044	W. BASS	1.50	32.5	680
BR 3045	W. BASS	0.43	30.5	500
BR 3046	W. BASS	0.89	33.6	645
BR 3047	W. BASS	0.95	31.2	555
BR 3048	W. BASS	0.74	32.2	680
BR 3049	W. BASS	1.50	30.0	520
BR 3050	W. BASS	0.74	33.7	680
BR 3051	W. BASS	1.20	29.4	515
BR 3052	W. BASS	0.59	28.2	435
BR 3053	W. BASS	0.92	31.0	555
BR 3054	W. BASS	1.20	31.9	665
BR 3055	W. BASS	1.40	31.7	680
BR 3056	W. BASS	0.58	28.2	515
BR 3057	W. BASS	0.89	29.2	460

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 4

#		SPECIES	HG	LENGTH	WEIGHT
BR	3058	W. BASS	1.30	32.8	685
BR	3059	W. BASS	1.10	29.3	440
BR	3930	C. CATFISH	0.48	22.3	200
BR	3061	W. BASS	0.27	24.1	245
BR	3062	W. BASS	0.29	23.4	210
BR	3063	W. BASS	0.25	21.9	165
BR	3064	R. BASS	1.40	21.0	210
BR	3065	R. BASS	1.80	25.4	330
BR	3066	S.M. BASS	0.75	25.7	290
BR	3067	S.M. BASS	0.50	29.2	440
BR	3068	S.M. BASS	0.74	27.3	415
BR	3069	Y. PERCH	0.51	24.5	195
BR	3070	Y. PERCH	1.10	26.5	250
BR	3906	WALLEYE	2.40	65.1	2890
BR	3907	R. BASS	0.17	14.8	70
BR	3908	R. BASS	0.90	21.2	211
BR	3909	R. BASS	0.58	19.4	193
BR	3910	R. BASS	0.79	19.4	175
BR	3911	PIKE	1.60	90.2	5655
BR	3912	CARP	0.63	39.6	1107
BR	3913	CARP	0.34	42.5	1545
BR	3914	S.M. BASS	0.89	28.9	440
BR	3915	S.M. BASS	0.76	30.2	490
BR	3916	S.M. BASS	1.20	32.5	580
BR	3917	S.M. BASS	0.35	23.4	215
BR	3918	Y. PERCH	0.36	21.3	120
BR	3919	W. SUCKER	0.06	34.6	580
BR	3920	W. SUCKER	0.34	36.7	666
BR	3921	W. SUCKER	0.18	38.6	950
BR	3922	W. SUCKER	0.50	36.4	604
BR	3923	WALLEYE	2.40	67.0	3527
BR	3924	PIKE	0.44	70.6	2750
BR	3925	PIKE	0.45	72.4	3065
BR	4069	WALLEYE	1.60	37.0	510
BR	4070	WALLEYE	0.22	38.3	595
BR	4071	WALLEYE	2.20	60.9	2690
BR	4072	WALLEYE	0.26	60.3	2606
BR	4073	WALLEYE	1.90	61.8	2427
BR	4074	WALLEYE	2.40	66.8	4087
BR	4075	WALLEYE	1.40	63.6	3087
BR	4076	WALLEYE	1.60	61.9	2233
BR	4077	WALLEYE	1.60	60.3	2350
BR	4078	WALLEYE	1.80	65.1	3143
BR	4079	WALLEYE	1.30	62.3	2650
BR	4080	WALLEYE	1.70	63.3	2813
BR	4081	WALLEYE	1.50	60.2	2508
BR	4082	WALLEYE	2.30	63.2	2700
BR	4083	WALLEYE	1.20	59.1	2533
BR	4084	WALLEYE	0.21	33.6	410
BR	4085	WALLEYE	0.35	33.0	357

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 5

#	SPECIES	HG	LENGTH	WEIGHT
BR 4086	WALLEYE	0.45	39.2	612
BR 4087	WALLEYE	0.49	39.5	660
BR 4088	R. BASS	1.40	24.2	270
BR 4089	R. BASS	1.30	22.7	225
BR 4090	R. BASS	1.00	22.8	225
BR 4091	R. BASS	0.93	20.9	198
BR 4092	R. BASS	0.64	20.2	187
BR 4093	R. BASS	0.60	19.5	158
BR 4094	R. BASS	0.84	20.5	206
BR 4095	R. BASS	0.48	17.3	110
BR 4096	R. BASS	0.31	16.0	110
BR 4097	S.M. BASS	2.70	45.5	1497
BR 4098	S.M. BASS	1.00	36.0	712
BR 4099	S.M. BASS	0.97	35.8	717
BR 4100	S.M. BASS	1.80	43.7	1294
BR 4101	Y. PERCH	0.96	25.7	247
BR 4102	W. BASS	1.40	32.5	616
BR 4103	W. BASS	0.72	42.8	1096
BR 4104	W. BASS	0.72	41.5	967
BR 4105	W. BASS	0.11	35.9	665
BR 4106	PIKE	1.10	70.3	2720
BR 4107	C. CATFISH	1.20	58.1	2784
BR 4108	C. CATFISH	1.00	59.0	3620
BR 4109	CARP	1.10	52.7	2759
BR 4110	CARP	0.77	54.2	3115
BR 4111	CARP	1.00	53.8	3108
BR 4112	CARP	0.81	48.7	2314
BR 4113	CARP	0.19	50.2	2773
BR 4114	CARP	0.45	48.6	2269
BR 4115	CARP	0.80	47.3	2431
BR 4116	CARP	0.75	45.4	1940
BR 4117	CARP	0.35	40.5	1242
BR 3941	W. SUCKER	0.92	38.9	654
BR 3942	PIKE	0.20	64.7	2130
BR 3943	MUSKIE	1.80	97.3	7900
BR 3944	R. BASS	0.50	19.8	210
BR 3945	R. BASS	0.67	23.9	300
BR 3946	CARP	1.20	44.7	1927
BR 3947	CARP	0.48	48.5	2213
BR 3948	CARP	0.42	44.5	2290
BR 3949	CARP	0.42	51.7	2804
BR 3950	CARP	0.95	53.8	3235
BR 3951	CARP	0.75	50.5	2893

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 6

#	SPECIES	HG	LENGTH	WEIGHT
TC 2870	WALLEYE	1.10	55.9	2024
TC 2871	WALLEYE	1.30	52.3	1370
TC 2872	WALLEYE	0.50	46.3	1031
TC 2873	WALLEYE	0.46	46.1	1111
TC 2874	WALLEYE	0.63	54.0	856
TC 2875	WALLEYE	0.27	35.4	455
TC 2876	S.M. BASS	1.00	33.2	640
TC 2877	W. BASS	0.27	27.6	374
TC 2878	R. BASS	1.60	24.8	273
TC 2879	R. BASS	0.39	18.0	132
TC 2880	C. CATFISH	0.98	43.5	1205
TC 2881	MUSKIE	0.24	76.5	3343
TC 2882	WALLEYE	1.50	55.9	2024
TC 2883	WALLEYE	0.93	52.3	1370
TC 2884	WALLEYE	0.42	46.3	1031
TC 2885	WALLEYE	0.44	46.1	1111
TC 2886	WALLEYE	0.50	54.0	856
TC 2887	WALLEYE	0.25	35.4	455
TC 3212	WALLEYE	0.26	32.5	285
TC 3213	WALLEYE	0.30	36.2	440
TC 3214	WALLEYE	0.53	44.0	850
TC 3215	WALLEYE	0.98	27.4	205
TC 3216	WALLEYE	0.64	43.5	930
TC 3218	WALLEYE	0.31	36.0	415
TC 3219	WALLEYE	0.23	33.9	340
TC 3220	WALLEYE	0.28	34.7	445
TC 3221	WALLEYE	0.33	37.0	480
TC 3222	WALLEYE	0.58	43.0	800
TC 3223	WALLEYE	1.10	43.2	790
TC 3224	WALLEYE	0.49	44.4	940
TC 3225	WALLEYE	0.95	43.6	830
TC 3226	WALLEYE	0.73	39.8	645
TC 3227	WALLEYE	0.52	41.1	685
TC 3228	WALLEYE	0.37	32.2	345
TC 3229	WALLEYE	1.10	60.6	2340
TC 3230	WALLEYE	1.10	61.8	3375
TC 3150	WALLEYE	0.19	32.5	285
TC 3151	WALLEYE	0.28	36.2	440
TC 3152	WALLEYE	0.47	44.0	850
TC 3153	WALLEYE	0.19	27.4	205
TC 3154	WALLEYE	1.10	43.5	930
TC 3155	WALLEYE	0.61	43.8	863
TC 3156	WALLEYE	0.15	36.0	415
TC 3157	WALLEYE	0.11	33.9	340
TC 3158	WALLEYE	0.26	34.7	445
TC 3159	WALLEYE	0.28	37.0	480
TC 3160	WALLEYE	0.52	43.0	800
TC 3161	WALLEYE	1.00	43.2	790
TC 3162	WALLEYE	0.48	44.4	940
TC 3163	WALLEYE	0.36	43.6	830

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 7

#	SPECIES	HG	LENGTH	WEIGHT
TC 3164	WALLEYE	0.63	39.8	645
TC 3165	WALLEYE	0.43	41.1	685
TC 3166	WALLEYE	0.32	32.2	345
TC 3167	WALLEYE	0.94	60.6	2340
TC 3168	WALLEYE	0.36	61.8	3375
TC 3169	W. BASS	0.55	30.4	457
TC 3170	W. BASS	0.72	29.8	783
TC 3171	W. BASS	0.54	28.7	450
TC 3172	W. BASS	0.55	30.0	451
TC 3173	W. BASS	0.94	32.2	618
TC 3174	W. BASS	0.36	35.5	760
TC 3175	W. BASS	1.80	30.8	515
TC 3176	W. BASS	1.30	28.3	415
TC 3177	W. BASS	0.12	20.9	154
TC 3178	W. BASS	0.76	31.8	480
TC 3179	W. BASS	0.51	30.6	590
TC 3180	W. BASS	0.33	31.8	550
TC 3181	W. BASS	1.60	31.9	615
TC 3182	W. BASS	0.40	35.8	680
TC 3183	W. BASS	1.80	29.2	465
TC 3184	W. BASS	1.30	23.7	245
TC 3185	S.M. BASS	1.24	44.4	1250
TC 3186	R. BASS	0.21	17.5	120
TC 3187	R. BASS	0.96	20.2	172
TC 3188	MUSKIE	0.49	74.5	3643
TC 3926	Y. PERCH	0.30	18.9	90
TC 3927	W. BASS	0.10	24.5	260
TC 3928	CARP	0.27	56.6	3940
TC 3929	C. CATFISH	0.35	39.2	760
TC 3898	W. BASS	1.10	35.0	875
TC 3899	R. BASS	1.60	24.5	285
TC 3900	R. BASS	1.00	21.5	254
TC 3901	R. BASS	0.86	18.5	137
TC 3902	CARP	1.00	57.9	3570
TC 3903	C. CATFISH	0.79	42.1	1071
TC 3904	C. CATFISH	0.98	43.1	1065
TC 3905	C. CATFISH	0.42	39.8	818
TC 3936	Y. PERCH	0.52	22.4	157
TC 3937	W. BASS	0.81	29.8	523
TC 3939	W. SUCKER	0.30	44.3	1025
TC 3940	CARP	1.10	46.4	2114

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 8

#		SPECIES	HG	LENGTH	WEIGHT
MB	3071	WALLEYE	0.29	39.7	648
MB	3072	WALLEYE	1.60	44.3	875
MB	3073	WALLEYE	0.42	28.3	608
MB	3074	L.M. BASS	1.50	34.5	630
MB	3075	L.M. BASS	0.89	34.0	668
MB	3076	L.M. BASS	2.00	27.6	800
MB	3077	S.M. BASS	1.80	35.9	665
MB	3078	S.M. BASS	2.40	43.5	1278
MB	3079	W. BASS	0.91	30.0	463
MB	3080	W. BASS	0.47	31.4	665
MB	3081	B. CRAPPIE	0.80	27.7	345
MB	3082	B. CRAPPIE	0.34	22.7	223
MB	3083	B. CRAPPIE	0.70	22.2	224
MB	3084	B. CRAPPIE	0.58	25.4	402
MB	3085	B. CRAPPIE	1.70	28.4	420
MB	3086	B. CRAPPIE	0.80	25.7	320
MB	3087	B. CRAPPIE	1.10	28.4	432
MB	3088	B. CRAPPIE	0.64	22.5	236
MB	3089	B. CRAPPIE	0.79	25.5	314
MB	3090	B. CRAPPIE	1.70	27.3	398
MB	3091	B. CRAPPIE	0.44	22.3	204
MB	3092	B. CRAPPIE	0.63	22.0	198
MB	3093	B. CRAPPIE	0.39	22.9	236
MB	3094	B. CRAPPIE	0.60	23.8	269
MB	3095	B. CRAPPIE	0.45	24.8	287
MB	3096	B. CRAPPIE	1.90	27.7	383
MB	3097	B. CRAPPIE	0.47	19.8	140
MB	3098	B. CRAPPIE	0.71	26.3	380
MB	3099	B. CRAPPIE	0.53	24.9	285
MB	3100	B. CRAPPIE	0.33	22.7	229
MB	3101	B. CRAPPIE	0.59	21.7	167
MB	3102	B. CRAPPIE	0.58	20.2	148
MB	3103	B. CRAPPIE	0.60	22.7	214
MB	3104	B. CRAPPIE	0.33	22.7	236
MB	3105	B. CRAPPIE	0.58	21.5	173
MB	3106	B. CRAPPIE	1.00	26.0	330
MB	3107	B. CRAPPIE	1.30	25.7	325
MB	3108	B. CRAPPIE	0.30	20.5	154
MB	3109	B. CRAPPIE	0.89	27.2	413
MB	3110	B. CRAPPIE	0.30	24.0	387
MB	3111	B. CRAPPIE	0.74	21.3	293
MB	3112	B. CRAPPIE	0.45	18.8	125
MB	3113	B. CRAPPIE	0.37	22.2	212
MB	3114	B. CRAPPIE	0.73	25.7	327
MB	3115	B. CRAPPIE	2.00	24.1	290
MB	3118	B. CRAPPIE	0.22	19.2	128
MB	3119	B. CRAPPIE	0.64	22.0	200
MB	3120	B. CRAPPIE	0.91	27.2	421
MB	3121	B. CRAPPIE	0.59	20.8	177
MB	3122	B. CRAPPIE	0.48	21.0	168

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 9

#		SPECIES	HG	LENGTH	WEIGHT
MB	3123	B. CRAPPIE	0.66	24.4	276
MB	3124	B. CRAPPIE	0.32	21.4	186
MB	3125	B. CRAPPIE	0.46	24.0	300
MB	3126	B. CRAPPIE	0.50	22.8	222
MB	3127	B. CRAPPIE	0.37	19.2	125
MB	3128	B. CRAPPIE	0.87	23.0	213
MB	3129	B. CRAPPIE	0.29	19.3	125
MB	3130	B. CRAPPIE	0.24	18.0	100
MB	3131	R. BASS	1.20	21.6	223
MB	3132	R. BASS	0.63	20.8	185
MB	3133	P'SEED	0.51	18.8	182
MB	3134	P'SEED	0.77	20.0	198
MB	3135	P'SEED	0.66	19.5	187
MB	3136	P'SEED	0.35	17.0	134
MB	3137	BLUEGILL	0.48	18.7	172
MB	3138	BLUEGILL	0.79	20.0	213
MB	3139	BLUEGILL	0.70	19.8	213
MB	3140	BLUEGILL	0.47	15.6	108
MB	3141	BLUEGILL	0.64	19.9	208
MB	3142	BLUEGILL	0.54	21.8	295
MB	3143	BLUEGILL	0.80	19.5	172
MB	3144	PIKE	0.45	45.4	596
MB	3145	PIKE	1.00	69.1	2100
MB	3146	PIKE	0.73	56.8	1200
MB	3147	PIKE	2.20	66.2	2116
MB	3148	PIKE	1.10	65.8	1994
MB	3149	PIKE	2.30	79.5	3136
MB	3209	WALLEYE	0.30	39.7	648
MB	3210	WALLEYE	1.40	44.3	875
MB	3211	WALLEYE	0.45	28.3	608
MB	3865	W. BASS	1.90	35.7	762
MB	3866	PIKE	2.40	68.8	2010
MB	3867	PIKE	2.20	59.9	1440
MB	3868	PIKE	1.10	66.0	1915
MB	3869	PIKE	1.20	57.2	1380
MB	3870	PIKE	0.96	57.0	1355
MB	3871	PIKE	1.40	52.5	870
MB	3872	PIKE	1.60	50.5	717
MB	3873	W. SUCKER	0.71	49.9	1690
MB	3874	W. SUCKER	1.40	43.0	990
MB	3875	W. SUCKER	0.94	47.9	1350
MB	3876	R. BASS	1.60	23.1	271
MB	3877	R. BASS	1.70	25.3	363
MB	3878	R. BASS	1.40	21.2	220
MB	3879	R. BASS	1.40	20.7	175
MB	3880	R. BASS	0.84	21.0	200
MB	3881	R. BASS	0.69	19.8	170
MB	3882	R. BASS	1.40	17.8	132
MB	3883	R. BASS	0.85	22.7	240
MB	3884	R. BASS	1.70	21.3	233

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 10

#	SPECIES	HG	LENGTH	WEIGHT
MB 3885	R. BASS	1.30	21.2	220
MB 3886	R. BASS	0.90	18.5	145
MB 3887	S.M. BASS	0.96	34.5	760
MB 3888	L.M. BASS	2.10	31.4	470
MB 3889	L.M. BASS	1.20	30.8	490
MB 3890	L.M. BASS	1.80	37.1	860
MB 3891	L.M. BASS	1.60	39.6	1033
MB 3892	L.M. BASS	0.89	29.6	420
MB 3893	Y. PERCH	0.70	19.5	105
MB 3894	CARP	1.00	67.2	5445
MB 3895	CARP	0.74	58.0	3875
MB 3896	CARP	0.66	60.0	3272
MB 3897	CARP	0.46	42.2	1610
MB 3930	PIKE	1.30	78.3	3060
MB 3931	PIKE	1.90	67.2	2100
MB 3932	PIKE	0.66	54.6	1050
MB 3933	CARP	0.84	66.3	5210
MB 3934	CARP	1.30	55.6	3890
MB 3935	CARP	0.48	55.8	3090
MB 3952	PIKE	3.80	91.0	5930
MB 3953	PIKE	2.00	73.4	2620
MB 3954	PIKE	1.20	64.3	1750
MB 3955	PIKE	2.00	58.8	1320
MB 3956	PIKE	1.30	63.7	1517
MB 3957	PIKE	2.50	59.7	1232
MB 3958	PIKE	1.00	57.4	1262
MB 3959	PIKE	0.67	66.5	2005
MB 3960	Y. PERCH	1.10	19.8	110
MB 3961	R. BASS	1.50	23.4	300
MB 3962	R. BASS	1.20	22.0	245
MB 3963	R. BASS	0.86	21.5	250
MB 3964	R. BASS	2.20	18.7	155
MB 3965	R. BASS	1.30	24.5	365
MB 3966	R. BASS	1.80	23.2	325
MB 3967	R. BASS	1.40	23.0	280
MB 3968	R. BASS	1.50	23.6	335
MB 3969	R. BASS	0.94	20.2	177
MB 3970	R. BASS	0.68	17.3	120
MB 3971	R. BASS	0.40	15.3	90
MB 3972	R. BASS	0.97	14.4	63
MB 3973	L.M. BASS	0.95	22.9	204
MB 3974	CARP	1.20	46.5	1865
MB 3975	CARP	0.65	53.8	3333
MB 3976	CARP	0.78	53.6	3391
MB 3977	CARP	0.44	50.8	2804
MB 3978	CARP	0.28	55.1	2792
MB 3979	CARP	0.62	43.5	1755
MB 3980	CARP	0.80	56.3	3660
MB 3981	CARP	0.31	56.8	3540
MB 3982	CARP	1.40	39.3	1240

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 11

#	SPECIES	HG	LENGTH	WEIGHT
MB 3983	CARP	0.71	65.9	5880
MB 3984	CARP	0.94	55.8	3750
MB 3985	CARP	0.35	51.3	3080
MB 3986	CARP	1.20	44.4	1839
MB 3987	CARP	1.30	58.3	3650
MB 3988	CARP	0.24	59.6	4535
MB 3989	CARP	0.86	41.4	1555
MB 3990	CARP	0.90	48.8	2267
MB 3991	CARP	0.76	48.8	2370
MB 3992	CARP	1.00	54.4	3003
MB 3993	CARP	0.91	60.3	4050
MB 3994	CARP	0.42	53.3	3257
MB 3995	CARP	1.10	39.2	1335
MB 3996	CARP	0.25	50.5	2977
MB 3997	CARP	0.74	40.2	1420
MB 3998	CARP	0.61	47.5	1800
MB 3999	CARP	0.26	50.3	2790
MB 4000	CARP	1.00	48.6	2545
MB 4001	CARP	0.97	58.7	4030
MB 4002	CARP	0.70	52.0	3480
MB 4003	CARP	1.00	51.6	2310
MB 4004	CARP	0.76	46.6	2318
MB 4005	CARP	0.80	58.3	4890
MB 4006	CARP	1.10	65.3	5550
MB 4007	CARP	0.46	55.0	3650
MB 4008	CARP	0.88	53.6	3077
MB 4009	CARP	1.10	41.9	1750
MB 4010	CARP	0.90	42.3	1675
MB 4011	CARP	0.22	38.8	1255
MB 4012	WALLEYE	2.20	61.2	2430
MB 4013	R. BASS	1.50	24.4	360
MB 4014	R. BASS	2.00	23.3	247
MB 4015	R. BASS	0.88	22.0	215
MB 4016	R. BASS	1.30	24.5	280
MB 4017	R. BASS	1.00	18.4	123
MB 4018	R. BASS	0.87	17.7	123
MB 4019	R. BASS	0.87	19.8	193
MB 4020	R. BASS	1.30	21.3	198
MB 4021	R. BASS	0.34	15.0	82
MB 4022	R. BASS	0.77	15.5	83
MB 4023	R. BASS	0.59	21.1	217
MB 4024	Y. PERCH	1.40	24.0	186
MB 4025	S.M. BASS	0.88	17.6	153
MB 4026	S.M. BASS	1.00	35.7	820
MB 4027	S.M. BASS	1.20	40.0	1253
MB 4028	L.M. BASS	1.00	32.6	616
MB 4029	L.M. BASS	1.20	34.0	683
MB 4030	L.M. BASS	1.10	29.5	428
MB 4031	L.M. BASS	1.80	34.4	738
MB 4032	L.M. BASS	1.10	29.7	432

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 12

#		SPECIES	HG	LENGTH	WEIGHT
MB	4033	W. BASS	1.30	34.4	712
MB	4034	W. BASS	0.91	33.6	638
MB	4035	W. BASS	1.30	31.7	562
MB	4036	PIKE	2.70	57.4	1005
MB	4037	PIKE	1.70	80.1	3475
MB	4038	PIKE	1.60	77.4	3043
MB	4039	PIKE	2.00	73.0	3128
MB	4040	PIKE	2.70	86.6	4428
MB	4041	W. SUCKER	1.80	42.5	1195
MB	4042	W. SUCKER	1.20	43.7	1040
MB	4043	C. CATFISH	0.68	60.5	3063
MB	4044	C. CATFISH	0.67	53.4	1841
MB	4045	C. CATFISH	1.40	60.1	2078
MB	4046	C. CATFISH	1.40	55.7	2383
MB	4047	CARP	1.00	42.3	1763
MB	4048	CARP	1.10	49.5	2342
MB	4049	CARP	1.00	51.7	2908
MB	4050	CARP	0.95	51.6	2850
MB	4051	CARP	1.30	52.6	3181
MB	4052	CARP	0.45	45.2	1853
MB	4053	CARP	0.76	49.4	2853
MB	4054	CARP	0.34	49.0	2127
MB	4055	CARP	1.40	48.7	1732
MB	4056	CARP	1.50	66.7	6870
MB	4057	CARP	1.10	61.0	4610
MB	4058	CARP	0.79	52.5	2855
MB	4059	CARP	0.46	46.4	2387
MB	4060	CARP	1.00	64.4	5007
MB	4061	CARP	1.10	66.5	5767
MB	4062	CARP	0.91	58.1	4145
MB	4063	CARP	0.16	33.5	825
MB	4064	CARP	0.75	52.1	2965
MB	4065	CARP	0.58	49.4	2190
MB	4066	CARP	0.84	55.4	3823
MB	4067	CARP	1.50	50.0	2270
MB	4068	CARP	0.85	54.1	2912
MB	4645	CARP	0.97	70.3	7280
MB	4646	CARP	1.20	72.4	7485
MB	4647	CARP	0.77	60.4	4711
MB	4648	CARP	0.51	66.2	6037
MB	4649	CARP	1.10	75.4	8855
MB	4650	CARP	0.88	67.3	6380
MB	4651	CARP	1.18	60.8	4295
MB	4652	CARP	0.62	60.2	6203
MB	4653	CARP	1.19	62.6	4690
MB	4654	CARP	1.15	73.2	8132
MB	4655	CARP	0.77	64.5	5290
MB	4656	CARP	0.72	63.5	5612
MB	4657	CARP	0.91	67.4	6378
MB	4658	CARP	0.82	63.2	6645

*****MOE MERCURY RAW DATA*****

ST. CLAIR, 1976 DATA FILE # 13

#		SPECIES	HG	LENGTH	WEIGHT
MB	4659	CARP	1.06	61.5	4785
MB	4660	C. CATFISH	0.57	49.8	1810
MB	4661	C. CATFISH	0.64	53.2	2215
MB	4662	W. SUCKER	1.40	42.3	1125
MB	4663	W. SUCKER	0.98	44.4	1195
MB	4664	W. SUCKER	1.90	44.8	1140
MB	4665	W. SUCKER	1.15	45.4	1320
MB	4666	W. BASS	1.29	34.6	754
MB	4667	R. BASS	1.86	25.9	353
MB	4668	S.M. BASS	0.74	38.4	1080
MB	4669	S.M. BASS	3.67	45.0	1600
MB	4670	PIKE	2.27	69.5	2105
MB	4671	PIKE	2.27	77.3	3446
MB	4672	PIKE	0.67	54.9	1170
MB	4673	PIKE	1.02	59.7	1285
MB	4674	PIKE	1.39	58.2	1440
MB	4675	PIKE	2.58	80.3	4020
MB	4676	PIKE	3.36	91.9	6000
BR	4677	PIKE	3.78	78.1	3375
BR	4678	PIKE	1.38	70.4	2490
BR	4679	MUSKIE	0.62	74.4	3630
BR	4680	W. SUCKER	0.85	42.8	1012
BR	4681	W. SUCKER	0.19	41.3	1013
BR	4682	W. SUCKER	0.21	37.5	775
BR	4683	W. SUCKER	0.21	46.1	1380
BR	4684	S.M. BASS	0.64	34.6	675
BR	4685	S.M. BASS	0.94	38.2	900
BR	4686	R. BASS	0.84	25.1	325
BR	4687	R. BASS	1.51	17.5	142
BR	4688	WALLEYE	0.29	28.6	240
BR	4689	WALLEYE	0.21	65.6	2870
BR	4690	Y. PERCH	2.60	26.2	220
TC	4691	CARP	0.57	62.8	4820
TC	4692	CARP	0.77	60.4	4172
TC	4693	C. CATFISH	1.27	45.7	1520
TC	4694	W. SUCKER	0.28	43.7	1100
TC	4695	S.M. BASS	1.21	36.6	865
TC	4696	S.M. BASS	1.18	34.4	730
TC	4697	S.M. BASS	0.65	33.2	690
TC	4698	R. BASS	0.87	24.4	322
TC	4699	R. BASS	1.70	25.5	290
TC	4700	R. BASS	1.69	24.4	339
TC	4701	WALLEYE	1.84	65.5	2740
TC	4702	Y. PERCH	2.86	18.8	73
TC	4703	Y. PERCH	0.11	17.7	70
MB	4704	W. SUCKER	0.54	43.1	1195
MB	4705	W. BASS	1.28	34.1	713
MB	4706	W. BASS	1.48	33.8	810
MB	4707	W. BASS	2.03	35.5	808
MB	4708	W. BASS	1.04	34.5	760

*****MOE MERCURY RAW DATA*****

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	#	SPECIES	HG	LENGTH	WEIGHT
MB	4709	W. BASS	0.78	33.2	787
MB	4710	W. BASS	1.19	35.1	890
MB	4711	W. BASS	1.47	32.4	640
MB	4712	L.M. BASS	1.05	31.9	551
MB	4713	R. BASS	1.31	23.2	278
MB	4714	R. BASS	1.46	24.6	362
MB	4715	PIKE	1.25	70.6	2557
MB	4716	PIKE	1.84	76.3	3077
MB	4717	PIKE	1.57	60.2	1447
MB	4718	PIKE	1.84	79.1	3125
MB	4719	PIKE	1.89	73.4	2295
MB	4720	PIKE	2.04	73.1	2430
MB	4721	C. CATFISH	0.55	57.5	3125
MB	4722	C. CATFISH	0.49	51.0	1730
MB	4723	C. CATFISH	0.71	45.2	1190
MB	4724	C. CATFISH	0.96	60.9	3192
MB	4725	C. CATFISH	1.18	59.7	3132
MB	4726	C. CATFISH	0.69	46.7	1442
MB	4727	C. CATFISH	0.80	53.8	2225
MB	4728	C. CATFISH	0.43	48.5	1440
MB	4729	C. CATFISH	0.81	49.2	1735
MB	4730	C. CATFISH	0.70	50.7	1840
MB	4731	C. CATFISH	1.89	67.8	3800
MB	4732	C. CATFISH	0.77	52.5	2050
MB	4733	C. CATFISH	0.48	56.7	2690
MB	4734	C. CATFISH	0.43	62.2	3897
MB	4735	C. CATFISH	0.80	60.2	2915
MB	4736	C. CATFISH	0.70	61.9	3829
MB	4737	C. CATFISH	1.00	54.8	2515
MB	4738	C. CATFISH	0.46	54.0	2330
MB	4739	C. CATFISH	0.47	47.6	1825
MB	4740	C. CATFISH	0.54	50.7	1965
MB	4741	C. CATFISH	0.63	58.6	3340
MB	4742	C. CATFISH	0.52	61.1	3770
MB	4743	C. CATFISH	0.80	61.4	3620
MB	4744	C. CATFISH	0.76	50.1	2005
MB	4745	C. CATFISH	0.58	57.2	3175
MB	4746	C. CATFISH	0.52	50.2	1795
MB	4747	C. CATFISH	0.63	56.8	2420
MB	4748	C. CATFISH	1.30	55.6	2290
MB	4749	C. CATFISH	0.89	61.8	2980
MB	4750	C. CATFISH	1.01	42.6	987
MB	4751	W. SUCKER	0.98	42.8	972
BR	4752	R. BASS	1.12	25.1	310
BR	4753	R. BASS	1.74	17.5	115
TC	4754	R. BASS	0.49	17.0	110
TC	4755	Y. PERCH	0.43	22.2	160
MB	4756	L.M. BASS	1.21	32.1	505
MB	4757	R. BASS	1.54	24.3	300
MB	4758	W. BASS	1.02	35.2	805

*****MOE MERCURY RAW DATA*****

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#		SPECIES	HG	LENGTH	WEIGHT
MB	4759	W. BASS	1.20	33.9	730
MB	4760	W. SUCKER	1.75	48.4	1455
MB	4761	PIKE	1.35	73.5	3310
MB	4762	C. CATFISH	0.57	44.8	1250
MB	4763	C. CATFISH	0.71	52.6	2160
MB	4764	C. CATFISH	0.63	50.0	2000
MB	4765	C. CATFISH	1.03	58.0	2260
MB	4766	C. CATFISH	0.80	54.6	2295

APPENDIX IV

SPECIES LIST

SPECIES LIST

Designation in this Report	Proper Name	Other Common Names
ALEWIFE	Alosa pseudoharengus	
BLACK CARPPIE	Pomoxis nigromaculatus	
BLUEGILL	Lepomis macrochirus	
BOWFIN	Amia calva	dogfish, lawyer
BROOK SILVERSIDES	Labidesthes sicculus	
BROWN BULLHEAD	Ictalurus nebulosus	
BURBOT	Lota lota	ling, maria ellpout
CARP	Cyprinus carpio	
CHANNEL CATFISH	Ictalurus punctatus	
EMERALD SHINER	Notropis atherinoides	
FRESHWATER DRUM	Aplodinotus grunniens	
GAR PIKE	Lepisosteus osseus	longnose gar
GIZZARD SHAD	Dorosoma cepedianum	
GOLDEN SHINER	Notemigonus crysoleucas	
LARGEMOUTH BASS	Micropterus dolomieui	
MOONEYE	Hiodon tergisus	
MUSKELLUNGE	Esox masquinongy	muskie, maskinonge lunge
PIKE	Esox lucius	northern pike jackfish
PUMPKINSEED	Lepomis gibbosus	
QUILLBACK CARPSUCKER	Carpiocles cyprinus	quillback sucker
REDHORSE SUCKER	Moxostoma macrolepidotum	shorthead redhorse sucker

SPECIES LIST (Cont'd)

Designation in this Report	Proper Name	Other Common Names
ROCK BASS	Ambloplites rupestris	
SMALLMOUTH BASS	Micropterus dolomieui	black bass
SPOTTAIL SHINER	Notropis hudsonius	
STURGEON	Acipenser fulvescens	lake sturgeon
TROUT PERCH	Percopsis omiscomaycus	
WALLEYE	Stizostideon vitreum	pickerel
WHITE BASS	Morone chrysops	
WHITE CRAPPIE	Pomoxis annularis	
WHITE SUCKER	Catostomus commersoni	
YELLOW PERCH	Perca flavescens	